Digital Utilities: A Kansas Perspective on Bridging Internet Divides with Municipal Broadband

By

H. Martin Koch
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Chair: Barney Warf

Germaine Halegoua

Shannon O'Lear

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The thesis committee for H. Martin Koch certifies that this is the approved version of the following thesis:

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Chair: Barney Warf

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Abstract

The venerable concept of universal service crucial to municipal utility operations may be the key to solving a digital-age challenge. Many rural Americans face persistent inequities in broadband Internet access, as low population density limits return on infrastructure investment. However, municipal broadband networks (MBNs) have already gained success at fostering economic growth, enhancing educational opportunities, and furthering social equity in places such as Chanute, KS and Chattanooga, TN. Municipalities are uniquely well-positioned to provide broadband due to their existing right-of-way assets and experience in providing utility services. Just as the 1930s-era Rural Electrification Administration programs helped double the number of farms receiving electricity in just five years, today, municipal broadband networks (MBNs) could meet the education, health, and economic development needs of 21st-century communities. Rather than shutting out private providers, they create choice that stimulates marketplace competition. This research identifies what challenges face municipal broadband adoption, how these challenges vary based on unique local conditions, and how informed management practices can help overcome them. Using an online survey with pre-coded and open-ended questions, I collected data from 38 managers in Kansas communities, 2 with and 36 without MBNs. These results help illustrate the benefits of and barriers to municipal broadband, and disseminate best practices in utility management. Specifically, this research focuses on the perceived incentives and disincentives of MBN implementation, and how these shape short-term and long-term implementation choices at the urban and rural scales. This project could help communities power a new generation of prosperity by harnessing tacit knowledge to implement more efficient, equitable, and effective information systems.

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0 - Initializing

Can a better connection to cyberspace save a real-world place? Many residents of Chattanooga, TN believe so. Located in the heart of the Appalachia, a long-marginalized and deeply stigmatized region, Chattanooga achieved the dubious distinction of possessing the 'worst quality' air in the United States during the 1970s (Koebler 2016). However, Chattanooga has recently gained prominence for innovative prosperity rather than industrial decline. Startups rather than smokestacks drive a burgeoning creative economy that has turned Chattanooga into an agglomeration of technology firms and a magnet for human capital from across the nation. While Silicon Valley, Austin, and Boston's Route 128 rose to prominence on a foundation of elite universities and cutting-edge defense research, Chattanooga's innovative journey began somewhere more prosaic: a municipal electric utility.

In 2010, Chattanooga's publicly-owned electric power provider, EPB, harnessed a $169 million loan and a $111 million federal stimulus grant to upgrade its fiber-optic-based 'smart grid' from an outage monitoring system to a full-fledged broadband Internet service provider (Koebler 2016). EPB overcame four lawsuits and an intense public relations campaign funded by incumbent telecommunications companies with the intent of discrediting municipal broadband. Today, their network offers connection speeds up to 10 gigabits/second, the highest available anywhere in the United States (Koebler 2016). The city of Chattanooga, where smog from factory emissions was once so thick that residents drove with their headlights on at midday, now lights the way for a path of broadband innovation. The Chattanooga broadband model could provide other peripheral communities, many of which are struggling with population loss and obsolescence in the era of cognitive-cultural capitalism, with an on-ramp to the information highway. By stimulating competition among ISPs and raising the speed of available Internet connections, municipal broadband can help attract new firms and bolster the capacity of existing firms to create jobs and higher-value products.

0.1 – Project Summary

This project aims to uncover means in which rural communities underserved by private Internet providers can build solutions suited to their local context using municipal broadband networks (MBNs). The precise meaning of 'municipal broadband' is contested, but The International Center for Applied Studies in Information Technology at George Mason University defines it as "broadband Internet access services provided either fully or partially by local governments" (ICASIT 2016).

Chapter 2 places my work in the context of existing cybergeography research and outlines the 'digital divide' problems for which MBNs may offer a solution. It outlines both the broader context in which digital technologies are anchored in geographic space, as well as the specific context through which access to such technologies is constructed in an inequitable manner by social, political, and economic systems.

Chapter 3 focuses on current and historical developments that have shaped the MBN landscape in the U.S. MBNs have successfully expanded broadband access opportunities for a diverse range of communities, but face challenges that limit the speed and scope of their construction.

Chapter 4 describes the methods in which I gathered both primary and secondary data sets. The former data set comes directly from responses to a survey of municipal leaders in the state of Kansas. The latter comes from demographic data collected by the U.S. Census Bureau's American Community Survey.

Chapter 5 synthesizes the patterns revealed by analysis through descriptive statistics, inferential statistics, and qualitative interpretation. It addresses the perceptions of MBNs among mangers of communities that have already implemented MBNs, communities that plan to implement MBNs in the near term, and communities that do not plan to implement MBNs.

Chapter 6 links these patterns to concrete steps for promoting digital innovation among American community leaders. It aims to place my findings and analysis in the practical context of actionable policy measures that can improve connectivity for real-world communities in the state of Kansas and beyond. My research concentrates on two main areas of contribution to the body of cybergeography scholarship. Ultimately, I aim to help restore the importance of spatial analysis in studies of information and communication technology. Additionally, I aim to help resurrect the fortunes of rural communities, which are far too often left behind by a post-Fordist economy based on the production of symbolic goods distributed in a space of accelerating information flows only accessible through capital-intensive infrastructure.

0.2 – Research Questions

My study aims to answer a common question I heard when colloquially sharing my work with members of the public and community stakeholders: "I could certainly use a faster or more reliable Internet connection … why doesn't my community have municipal broadband?" To address this issue, I am interested in answering the research question of 'What incentives and disincentives impact municipal leaders as they make decisions regarding municipal broadband?' Related questions include 'In both perception and actuality, what are the most significant benefits of and challenges to implementing MBNs?' I also aim to determine 'How do municipal leaders learn about municipal broadband to gain information for making such decisions?' as well as ‘What are municipal leaders most interested in learning about municipal broadband?’ By definition, local government institutions rather than private citizens implement MBNs, so my analysis foregrounds the perspective of municipal managers and administrators. I aim to identify effective professional development strategies for MBN education. I also aim to uncover how those in positions of authority and influence perceive MBNs, and how professional development affects their perceptions. As a geographer, I am interested in learning ‘How do unique community characteristics influence MBN development?’ Additionally, since the field of municipal broadband evolves at a rapid pace, I seek to learn about ‘What plans do communities have for the future of MBNs?’, and ‘How do co-constitutive managerial and citizen advocacy factors shape the next generation of local Internet innovation’? The deployment of municipal utilities may initially appear to be technologically determined. However, while utility infrastructure is physically installed below ground, its development is also metaphorically ‘grounded’ in social structures that bridge both the digital divides between citizens, as well as the more abstract divide between cyberspace and geographic sense of place. The process of constructing municipal utility infrastructure often begins with digging a trench in the material landscape. This process is a fitting metaphor, as such infrastructure serves to ‘entrench’ existing power relationships within the social landscape. Perhaps the greatest and most comprehensive ‘digital divide’ is the gap between the liberatory, transformative potential of the Information Superhighway and its current neoliberal incarnation.

0.3 - Statement of Positionality

I became interested in broadband access issues while working as an Oklahoma Broadband Initiative undergraduate research assistant at the University of Oklahoma’s Center for Spatial Analysis. From the dirt roads of southeastern Oklahoma to the boardrooms of the State

Regents for Higher Education, I learned that successful research requires the skills to connect with a diverse array of communities while never taking 'I don't know' for an answer. I have lived and used the Internet in rural, urban, and suburban areas. Through internships with federal, state, and municipal agencies, I have learned about the public sector's important role in advancing community development. I am not alone in my passion for public-sector municipal broadband. Practitioners, policymakers, and pedagogues would all be interested in this topic.

My analysis is informed by themes of political economy as applied to cyberspace. Recent perspectives have challenged the metaphor of "cyberspace" as a characterization of the networked digital media landscape (Graham 2013). However, cybergeography scholar Rob Kitchin's definition of "cyberspace" as "computer-mediated communications and virtual reality technologies … center[d] upon the development and appropriation of the Internet" remains a useful if imperfect tool for linking the study of technology to a geographic perception of the world that foregrounds the impact of spatial phenomena (Kitchin 1998, 1). His summary of major competing outlooks for the legal regulation of the emerging cyberspatial domain was ahead of its time when published and remains currently relevant. Market libertarianism believes that entrepreneurial capitalism, as directed by a multitude of small, intensely-competitive firms, offers the best chance for an Internet future that provides users with an abundance of choice and value. Corporate conservatism holds that large transnational corporations are best equipped to settle the digital frontier. Both perspectives advocate for limited regulation, subsidization, and state intervention in Internet development (Kitchin 1998). They represent a neoliberal view of Internet development, in which autonomous market forces create abundant wealth and effective governance (Graham 2008). This cyber-optimist perspective allows no intellectual consideration of possible roles for the public sector (Morozov 2011).

Other perspectives provide a more pragmatic and less binary viewpoint. Mixed-market libertarianism acknowledges the key role of private firms in Internet development, but supports state interventions to prevent marginal groups from being excluded from the market due to low socioeconomic status (Kitchin 1998). Progressive communitarianism supports a more expansive role for the public sector. This framework calls for public ownership of backbone connection infrastructure, a key guidance and monitoring role for non-profit advocacy groups, the development of decentralized community networks, and a focus on universal access to Internet services (Kitchin 1998). This perspective underlies the range of programs underway to address the 'digital divide' at the national and international scales (Graham 2008). Rather than the binary market fundamentalist view, I most agree with the sentiments articulated by these latter two visions for Internet development. In the words of Morozov, "the recognition of the revolutionary nature of a technology is a poor excuse not to regulate it" (Morozov 2011, 282).

Partnerships between public and private sector actors, rather than unipolar corporate monopolies, are most likely to make cyberspace an inclusive system with universal positive effects on all of society, rather than only society's most geographically and economically privileged stratum. A balanced approach to regulation will help provide space for innovation while ensuring that Internet institutions remain accountable and accessible for all Americans. I am familiar with 'cyberpunk' science fiction literature, such as William Gibson's famed novel *Neuromancer*, which established the first known definition of 'cyberspace' and warned of the dystopian consequences that would result from its corporate control. While 'cyberpunk' visions of rebellion against the monopolization and commodification of reality serve primarily as exciting works of fiction, they also spark valuable imaginative geographies of cyberspace that, in many ways, seem startlingly prescient. The current sociotechnical landscape of the Internet brings to mind the phrase often attributed to Gibson: 'The future is already here…it's just unevenly distributed.' My work aims to analyze and facilitate alternative political economies of communications infrastructure to alleviate splintered development and help distribute technological progress in a more equitable manner.

1 - Anchoring Cyber Space in Physical Place

Information and communication technology, which has enabled the field of geography to enter a new era of spatial analysis and remote sensing, has also been implicated in conspiring to render the discipline obsolete. Popular intellectuals like Thomas Friedman proclaim that "place no longer matters" in a world where information crosses continents at the speed of light (Florida 2014, 8). The late 1990s 'Dot-Com' boom, and its more recent 'Web. 2.0' counterpart, prompted predictions that locations would lose relevance due to the shift of production and consumption to virtual spheres (Zook 2008).

Yet, reports of the death of geography are greatly exaggerated. Cyberspace is not merely a wrecking ball for the traditional boundaries of space and time, but a complex tool that renegotiates them in interconnected manners sensitive to historical and social context. Even as technology plays an ever-more-crucial role in economic production and social reproduction, place takes center stage as a prime mover for its development and diffusion. The digital space of information flows, often constructed by economic and societal elites, overlays rather than obliterates the traditional realm of place (Kitchin 1998). Spatial factors such as local infrastructure availability construct and mediate the experience of connectivity in unique ways for people in unique places (Purcell 2016). By facilitating the flow of information across regional and national borders, network technology can empower place-based activists to research issues and communicate alternative perspectives (O'Lear 1999). Media technologies amplify the discourses of local leaders and expand the spatial scale of social actions (Adams 1996). Sense of place is not obsolete, since local variables serve as gateways – or gatekeepers – between embodied users and information landscapes.

1.1 - Weaving a Changing Web

Modern cities, in which social capital is often created through Twitter, Facebook, and FourSquare, have been described as "social network machines" (Arribas-Bel et al. 2015, 231). The evolution of Internet user experiences during the past decade has created a new and unique paradigm in media perception. Information and communication technologies (ICT) have enabled the emergence of a novel form of social organization based on the global diffusion in networks of capital, goods, services, labor, communication, information, science, and technology (Castells 2005). Many researchers posit that the Internet has created an improved public sphere, with lower organizational barriers to entry, greater openness for citizen participation, and a more potent impact on society than traditional print or electronic mass media (Gerhards and Schäfer 2010). Digital network communications dramatically reduce the substantial costs associated with raising awareness of an issue via the gatekeepers of 'old' media (Lester and Hutchins 2009).

Social technology transformed the Internet from a platform for consuming refereed content to a springboard for generating, manipulating, and disseminating original content. This "many-to-many" architecture supplanted the preexisting "one-to-many" structure (Fekete 2015, 15). Therefore, 'Web 2.0' media are generated and disseminated through a social context, as users produce information in the form of 'user-generated content' for others to consume (Stephens 2013). Once limited to text platforms such as electronic mail and bulletin boards, the Internet now delivers audiovisual content, like YouTube videos and Netflix television programs, to massive audiences (Sandvig 2015). Cartographic content, such as the three-dimensional topographic maps available from platforms such as Google Earth, is also available to an unprecedented level. The development of participatory mapping has even brought a 'Web 2.0' perspective to geographic information, including neogeography. Just as Wikipedia relies upon the contributions of users, neogeography harnesses volunteered geographic information (VGI) to create richly contextual, locally relevant datasets (Wilson and Graham 2013). It complicates the traditional conception of a stark divide between the cartographer and map user (Dodge and Kitchin 2001b).

While ‘Web 2.0’ may have broken down the gatekeeping functions of media institutions, other barriers to free and equitable flows of information remain standing. Without fiber optic cables, server farms, cellular antennae, and the other actual machines that underpin the digital age, metaphorical ‘social network machines’ would grind to a halt. Histories of media infrastructure develop together with the ‘brick-and-mortar’ histories of architecture and urban construction (Mattern 2015). Real estate has not lost its importance; rather, the focus of real estate valuation has shifted from “’location, location, location’” to “’location, bandwidth, location’” (Malecki and Moriset 2008, 37). For instance, the One Wilshire building in Los Angeles, home to a ‘meet-me’ room where Internet connections from half a dozen carrier corporations converge, commands the highest price per square foot ever recorded in downtown L.A.’s history (Dourish 2015).

Mitchell proposes that “the new urban design task is not one of configuring buildings, streets, and public spaces … but one of writing computer code and deploying software objects” (Mitchell 1997, 160). He rightly acknowledges the importance of software to directing the flows of information that support modern economic and social processes, but overlooks ways in which the built environment provides infrastructure for digital connectivity. Software and space thrive in a mutually dependent relationship, the product of which is termed “code/space” by Kitchin and Dodge (2011).

Common colloquial perceptions of cyberspace, from Madison Avenue marketing campaigns to underground 'cyberpunk' literature, foreground a luminous, nebulous orb of connections. Academic analyses use similar themes to present the Internet as a pure space of ethereal flows, represented by diagrams with a high level of abstraction. For instance, the MIT Media Lab's "Anemone" portrayal uses a 3-D cartogram to highlight the number of users that visit different components of a given Web site (Dodge and Kitchin 2001a, 108). More recently, Paul C. Adams posited a model for media communication as a system of point-to-point arcs that transit upon their own endogenously-created planes of spatiotemporal existence (2017). Maps of Internet infrastructure and connection speed tiers are disproportionately created by private providers and focused on the global, rather than local, scale (Dodge and Kitchin 2001a). A model is only useful if the enhancement in understanding it provides outweighs its inherent loss in fidelity. The model of the Internet as an isolated, ethereal realm free of spatial context is limited in utility due to its distinct disconnection from social and historical reality.

Instead, the Internet relies upon the more prosaic infrastructure of glass fiber-optic tubes and, in far too many places, obsolete copper twisted-pair DSL and dial-up lines (Blum 2012). This phenomenon can be observed in studies of "carrier hotels," data centers where Internet connections from multiple firms converge to provide extremely reliable service for core industries (Glascock 2015). At the opposite end of the economic power spectrum, the materiality of the Internet emerges most prominently in places that lack advanced ICT access. Such peripheral areas suffer from a series of spatial disparities in infrastructure, known as a 'digital divide,' between urban and rural regions (Grubesic and Murray 2004). Even in developed nations such as Australia, sluggish Internet connections can render meaningful use of the Internet for social interactions and economic transactions difficult or impossible (Gibson 2016). The topology of the Information Superhighway is little more than an abstract curiosity for those too far from the on-ramp to catch a ride. Furthermore, its unequal distribution presents a significant roadblock to social mobility in an era already characterized by accelerating economic and cultural stratification.

1.2 - (Infra)structures of Inequality

Since the decline of the Fordist social contract and anti-monopoly legislation in the 1970s, regional inequality has skyrocketed within the U.S. (Longman 2015). The development of cognitive-cultural capitalism, in which symbolic content determines the use and exchange value of products, has led to increased workforce stratification (Scott 2011). While low-skilled workers on assembly lines in peripheral areas could easily manufacture uniform Fordist goods, the increasingly unique and symbolic qualities of cognitive-cultural goods demand high levels of education and social capital among production workers. Workers with low levels of human capital are increasingly shunted into service industries, while high-wage symbolic analysts cluster in urban areas with strong connections to global flows of capital and creativity (Scott 2011). Members of the former group comprise an industrial reserve 'precariat' who experience limited bargaining power, low wages, and tenuous terms of employment based on the ever-shifting conditions of interconnected global markets.

Patterns of digital ICT development and diffusion both construct and reflect patterns of accelerating spatio-economic inequality. As Graham and Marvin observe, "inequalities in physical and electronic space tend to be mutually reinforcing" (1996, 191). Places with advanced information infrastructure attract clusters of high-order economic activities, yet the capital required to construct such infrastructures is often only available to places that already possess significant comparative advantage. At the height of the late-1990s 'Tech Bubble,' just seven core metropolitan areas controlled half of U.S. network capacity (Moss and Townsend 2000). Urban corridors, such as San Francisco, Boston, and Austin, contained disproportionate concentrations of commercial (.com) domain name registrations and Internet content firms (Zook 2004a). Omaha, NE, regional financial services hub and home to one of the highest levels of millionaires per capita of any U.S. city, took advantage of its location at the crossroads of several transcontinental fiber-optic cable to further entrench its core position by creating over 100,000 telecommunications-related jobs (Kitchin 1998).

Today, citizens of the U.S. continue to face persistent broadband access inequalities, especially in impoverished inner-city areas and in rural areas with a low concentration of users per square mile. Among Organization for Economic Cooperation and Development (OECD) nations, the U.S. ranks 15th in per capita broadband subscriptions, and has an inequality coefficient double that of neighboring Canada (Howard, Busch and Sheets 2010). In 2010, the average cost per Mbps connection was 1.10 U.S. dollars, compared to 0.08 USD in Japan (Akiyoshi, Tsuchiya and Sano 2013). More recently, the World Economic Forum ranked America behind six other industrial peers in an analysis of national capability to harness ICT for promoting prosperity among all citizens (Giller 2014). While Americans' geographical imaginations often perceive the U.S. as a technological leader, comparative indices show an urgent need for progress in the area of citizen Internet access in order to keep the nation competitive on a global scale.

Despite its binary name, the American 'digital divide' is comprised of a spectrum of factors rather than a simple bifurcation between those who have Internet access and those who do not. Inequalities in connection speed, reliability, and digital skills construct a multitude of divides. For many Americans, the most important number defining their online experience is not the distinction between Web 1.0 and Web 2.0, but the megabits-per-second (Mbps) available through their technological platform. Just as location is central to the exchange value of a real estate parcel, the level of available bandwidth is central to the use value of an Internet connection (Dodge and Kitchin 2001a). The Federal Communication Commission defines broadband as "internet access that is always on" and provides service at speeds of "25 Mbps for downloads and 3 Mbps for uploads" (FCC 2014b). However, this definition can vary based on the interests involved. A group of U.S. Senators recently criticized the paltry standards of the U.S. Department of Agriculture's Community Connect program, which allows providers with speeds of just 4 Mbps to claim that they offer 'broadband' (Brodkin 2016b). The National Telecommunications Industry Association further dilutes the meaning of 'broadband,' including in its definition services which provide speeds as low as 768 kilobits-per second (Kbps) downstream and 200 Kbps upstream (Mack and Grubesic 2014).

Overall, half of rural Americans lack access to service that meets the FCC's standard (Wheeler 2014). Specifically, 72% of rural dwellers are unable to access the Internet at speeds greater than 3 Mbps (Warf 2013). Slow and antiquated dial-up connections are disproportionately found in rural areas, while fiber optic lines are more likely to serve residents of high-density regions due to the economies of scale available there (Warf 2013). Only 54.6% of rural Americans are able to access the Internet at download speeds greater than 25 Mbps, compared to 94% of urban Americans (FCC 2014a). Intermediate technologies such as digital subscriber lines, cable modems, and fixed wireless have also been deployed at disproportionately slow rates in low-density areas (Grubesic and Murray 2004). Even levels of mobile wireless coverage are often negatively associated with rurality (Riddlesden and Singleton 2014).

Issues of broadband access in schools underscore the rural digital divide. Educational institutions are especially important venues for Internet connectivity, as workers who are proficient with technology due to early exposure stand to earn far more income than those who lack such familiarity (Warf 2001). The FCC reports that 41% of rural schools lack access to high-speed fiber connections (Wheeler 2014). Digital divides are not limited to primary education. Only 66% of rural community colleges offer Internet-based courses, compared to 81% of their suburban counterparts. The ability of such institutions to offer online distance learning is limited by access to bandwidth among rural students (Cejda 2007). Substandard Internet connectivity inhibits youth from developing skills as 'digital natives' essential for success in many careers.

78% of rural Americans use the Internet, compared to 85% of urban Americans (Perrin and Duggan 2015). Rurality is not the only barrier to adequate or universal Internet connectivity. Other demographic factors illustrate the uneven topology of modern American networks, and represent ways in which digital-age inequities reproduce those of earlier generations. In the early years of Internet development, women were underrepresented among Internet users, but this gender gap has closed in recent years (Witte, Kiss and Lynn 2013). However, variations in ethnicity, education, and income still represent connectivity inequalities. For instance, the digital divide has been labeled a "racial ravine" due to the divergent rates of Internet adoption among Americans of different ethnic groups (Warf 2013). 97% of Asian-Americans report Internet usage, compared to only 79% of African-Americans (Perrin and Duggan 2015). 95% of college graduates report Internet usage, compared to 76% of high school graduates and 66% of those with no high school diploma (Perrin and Duggan 2015). 95% of households earning between $50,000 and $75,000 per year report Internet usage, compared to 74% of households earning less than $30,000 per year (Perrin and Duggan 2015). These statistics quantify the severe stratification experienced by many Americans in their attempts to utilize the Internet, and highlight the multidimensional intersectionality of digital divides.

Market forces, enabled by a historical suite of neoliberal policy measures, have constructed the stratified communications landscape of contemporary America. From 1933 Telecommunications Act to the wave of deregulations that began in 1984, telecommunications services were provided by a regulated monopoly with an emphasis on social and geographical equalization (Graham and Marvin 1996). In 1994, Senator Daniel Inouye introduced a bill in the mold of the Wilderness Act that would set aside 20% of all new telecommunications network capacity for noncommercial use; this bill failed to become law (Mitchell 1997). The Telecommunications Act of 1996 defined an objective of universal service, or equal access to advanced telecommunications platforms for both rural and urban Americans (Gabel 2007). Following the passage of this Act, Congress established a universal service fund to subsidize telecommunications access in isolated areas (Mack and Grubesic 2014). However, the most significant impact of the Telecommunications Act of 1996 was not the pittance it prompted for universal service, but rather its ultimate elimination of regulated monopolies. The Act, along with the breakup of the Bell System, inaugurated a new era in the ICT industry. This era, dubbed "telematics," replaced Keynesian regulation with potential competition among a variety of providers and services (Graham and Marvin 1996).

Following the deregulation of the American telecommunications industry, "providers seek to avoid … areas (where low densities inhibit economies of scale)" (Warf 2013, 125). When infrastructure investments are guided solely by market economics, "service providers are simply not incentivized to enter the market in rural areas" (Chary and Aikins 2010, 43). Positive feedback loops create a path dependency for economic development, as wealthier regions with higher levels of population density become even better connected due to lower broadband provision costs in such regions (Malecki and Moriset 2008). In a deregulated market environment, firms are free to engage in the "'cherry picking'" of markets that provide a high profit margin and the commensurate "'social dumping'" of less-lucrative customers (Graham and Marvin 1996, 205). Communications activists once viewed the Internet as an anarchic utopia where information could flow openly without the constraints of hierarchy and regulation (Graham and Marvin 1996). Freedom for providers to maximize profits has not necessarily translated into freedom for users to explore and utilize the resources of cyberspace. The 'Information Economy' has rapidly accelerated the commodification of information.

Its perverse incentives create a monopoly or oligopoly market structure among investor-owned utilities. For instance, over 90% of urban Americans are able to choose between two or more wireline broadband providers, while less than 60% of rural Americans have the same number of options (FCC 2014a). Just as railroad and grain elevator monopolies increased costs and hindered development for rural areas in the late 19th century, modern-day broadband monopolies restrict access to economic opportunities. Rural broadband inequalities are not determined simply by attenuation of signal over distance and other technical factors, but are instead primarily constructed by economic and policy structures. The concept of 'splintered urbanism' summarizes the trend in which the quality and accessibility of information infrastructure becomes increasingly bifurcated along class lines as regulatory imperatives give way to market incentives (Graham and Marvin 2002). Solutions to these inequalities demand the creation and maintenance of alternative systems for administration and service provision in the American telecommunications sector.

1.3 - Material Matters

However, much cybergeography literature focuses on the spatiotemporal compression brought about by advanced information and communication technologies, rather than barriers to accessing those technologies. Such barriers often operate within the material physicality of communications infrastructure, as well as the political economy that makes such infrastructure possible. The development of Internet infrastructure is not an ahistorical leap forward into an ethereal future, but a process with extensive parallels to the conception and concretization of other material systems. As early as 1988, Gillespie and Williams marveled that "When the time taken to communicate over 10,000 miles is indistinguishable from (that) … taken to communicate over 1 mile, then time-space convergence has taken place at a fairly profound scale" (Gillespie and Williams 1988, 1317). More recently, many cybergeographers have turned their attention to accessibility within cyberspace, and attempted to analyze how users perceive and inhabit virtual spaces (Kwan 2001).

For instance, Kellerman considers pedestrian human locomotion as approximately equivalent to the processes by which users explore cyberspace using ICT (Kellerman 2012). Additional cybergeography research has applied "an updated version of Sauer's "Morphology of Landscape" to reveal the role of online spaces in the production of material landscapes (Longan 2015). Some theories assert that cyberspace is a fluid landscape that lacks distinct fixed coordinates, makes agglomeration obsolete, and exists as "the binary inverse of geographical space" (Graham 2008). However, these analyses overlook how the corporeality of technological infrastructure restricts the ability of all users to act as carefree digital *flaneurs* in a vibrant media landscape. ICT enables new patterns of urban development, and the demand for ICT services in urban spaces shapes their continued future development as part of a recursive feedback system (Graham and Marvin 1996).

A study analyzing how the use of social networking services differed between rural and urban customers gave no mention to ways that connections to the Internet may differ among places (Gilbert, Karahalios and Sandvig 2008). Mitchell's overview of barriers to cyberspace access foregrounds virtual means of control, such as encryption algorithms and legal restrictions on the distribution of adult content (Mitchell 1997). He does recognize that information distribution systems have become "utilities … much like [the] water, gas, sewage, and electrical systems … so fundamental to modern cities" (Mitchell 1997, 62). However, energy utilities have historically underserved areas outside such cities, much as information utilities underserve them today.

In the words of acclaimed digital media scholar Lisa Parks, "there is a need to consider the external, material demands of information infrastructures in tandem with their internal dynamics" (Parks 2015, 121). Studies of physical place are not obsolete, as cyberspace does not appear in a vacuum. Rather, "access to information flows along with … the social and material infrastructure to handle flows of bits" (Purcell 2016, 140). Such infrastructure "exist[s] in an ecology that is social and technical, human and nonhuman" (Starosielski 2015, 67). O'Lear's analyses of the geopolitical implications surrounding international petroleum pipelines are strikingly applicable to broadband Internet infrastructure. Like pipelines, the physical infrastructures of broadband "serve as a conduit of power" as they "connect places … divide places … and signify relationships" across core and peripheral borders (O'Lear 2010, 66).

During the 19th and 20th centuries, subterranean resources such as coal and oil lent a material dimension to the development trajectories of nations, regions, states, and communities. Today, as developed states shift from an industrial to a post-industrial economy, the volume of information capable of being transferred across a given community's network infrastructure has a more significant impact on opportunities available to citizens of that community than the volume of minerals available for extraction. Industries and governments see cable networks and their associated flows of information as resources ripe for channelization and profit, just as rivers and oil reserves presented economic opportunities for earlier generations (Starosielski 2015). Volumetric materialities often underpin the capacity for information flows. Such materialities describe whether the data transmission lines buried beneath a place consist of copper, like the earliest components of telephone systems, or light-speed fiber optics. Underground reserves of copper once marked the potential for prosperity in communities such as Pima County, Arizona. Today, underground copper, at least in the form of antiquated communications infrastructure, poses a barrier to success in the modern era of cognitive-cultural capitalism. To paraphrase William Jennings Bryan, denizens of rural areas should not be 'crucified on a cross of copper,' but enlightened upon a platform of fiber-optic infrastructure.

1.4 - Sociotechnical Synthesis

Despite the important role of ICT in unleashing human capital, technology is a utility, not a destiny. During the 1970s, policymakers, community organizers, and electronics firms alike once saw cable television not as a means to bring content to remote areas, but as an outright panacea for crises of American society (Streeter 2004). Similar rose-colored rhetoric may accompany municipal broadband today, but it is important to remember that a lack of ICT is not the sole cause of socioeconomic underdevelopment. The content distributed by users of such networks can hamper their positive social externality. The growing volume of online extremism and the increasing abundance of hoax journalism in social media outlets has dramatically affected the landscape of American media and political discourse. Mitchell's example of hate groups flooding early online bulletin boards with unwanted messages proves prescient (Mitchell 1997). However, the digital divide remains a problem worth solving. As essential functions of society and commerce increasingly depend upon ICT, inequalities in technical infrastructure foster a positive feedback loop that accelerates and entrenches existing socioeconomic inequity (Malecki and Moriset 2008).

Rather than technological determinism, I am primarily inspired by the "New Materialist" school of system studies, which seeks to "heal the dialectic between structure and form" by taking both physical and social factors into account through a unique process of spatializing practices (Sandvig 2013, 101). Jane Bennett's description of the electrical grid as "'a volatile mix of coal, sweat, electromagnetic fields, profit motives, lifestyles, fantasies of mastery, [and] legislation" is a particularly vivid example (Parks and Starosielski 2015, 10). Digital landscapes can reflect, overlay, and shape their physical counterparts. Yet, the existence and accessibility of virtual communities is often dependent upon decisions made and actions taken or not taken by real-world communities in place. City administrators, planners, and local government participants occupy a leading role in orchestrating the formation of the information infrastructure (Graham and Marvin 1996). In turn, the development and application of infrastructure systems contains the capacity to reinforce or reinvent social power relations (Parks and Starosielski 2015). In the words of Winston Churchill, adapted by William J. Mitchell, "we make our networks, and our networks make us" (Mitchell 1997, 49).

The materiality of Internet infrastructure lends a metaphorical and physical heft to networked systems. These technologies empower their users to reach new heights of productivity and self-expression. However, the power relationship between people, place, and cyberinfrastructure establishes human institutions rather than sheer technological capacity as the guiding principle for the co-constitutive development of machines and society. Kitchin outlines four competing theoretical frameworks for understanding the relationship between technology and society: utopian-futurism, technological determinism, social-political constructivism, and political economy (Kitchin 1998). Each has a unique perspective on and relationship to the development of cyberinfrastructure across geographic space.

Utopian-futurism is a familiar trope of popular media and corporate advertisements for new technologies. It often "speaks with a religious fervor in technological tongues" (Kitchin 1998, 57). Its outlook brings to mind the aphorism 'when all you have is a hammer, everything looks like a nail.' Writers with this ideological orientation often view every ethical, economic, or political problem in western society as a 'nail' to be flattened with the universal 'hammer' of advanced technology. Many visions of the influence of cyberspace on the human condition follow a techno-utopian outlook, in which computer networking can automatically produce a better world brimming with hope and benefits for all (Kitchin 1998). Cyberutopianism presents a "quasi-religious belief in the power of the Internet to do supernatural things, from eradicating illiteracy in Africa to … opening up closed societies and flushing them with democracy" (Morozov 2011, 19).

Technological determinism moves one step further. This perspective argues that technology acts in a linear cause-and-effect process to actively and autonomously determine the shape of society, which is but a passive and reactive vessel for the unstoppable force of technological change (Kitchin 1998). Technological determinism frequently bypasses value judgements to speak in language of what 'will' rather than what 'should' occur. Alvin Toffler's tracts are a prominent example. Despite its problematic oversimplications, technological determinism maintains a foothold in contemporary studies (Oliver 2011).

Political economy and social constructivism serve as more humane and useful perspectives on the relationship between technological advancement and social development. The latter argues that technology is a product of social relations, and that society, nature, and technology form a complex, intertwined system of mutual creation and regulation (Kitchin 1998). It foregrounds human, rather than technical, agency. Political economy emphasizes economic rather than cultural systems of social relations. Specifically, it adopts a neo-Marxist perspective to argue that capitalist modes of production direct the evolution of technology and society (Kitchin 1998). Many writers within the political economy framework view cyberspace as an extension of capitalist social relations, in which power will flow along traditional lines of ownership and commodification (Kitchin 1998). Political economy posits a trend in which polarization will continue to accelerate based on division between the information-rich and information-poor members of society.

SCOT (Social Construction of Technology) theory serves as a counterpoint to political economy. Similar in theme to social constructivism, it aims to "identify, analyze, and explain causal relationships between social, institutional, and political factors and the development … of technologies" (Graham and Marvin 1996, 105). It contains four key focus areas: interpretive flexibility, relevant social groups, closure and stabilization, and wider societal context (Klein and Kleinman 2002). The key strength of SCOT is its holistic emphasis on institutional and personal decisions, rather than autonomous technological structures or deterministic political-economic logic. SCOT explains the nature of technology as primarily an outcome of the competing agendas and power relations that characterize human practice (Oliver 2011). It holds particular relevance for my survey research due to its focus on "micro-level social processes of human agency" (Graham and Marvin 1996, 105). These include the processes by which municipal managers learn about and make decisions regarding technological investment and development.

One key source of such information is tacit knowledge. Tacit knowledge is identified by Zook as a specific form of "know-how" – a set of skills and abilities – that is transferred via "know-who," or "the density and strength of social networks" (2004b, 622). Even though advanced technologies can transmit symbolic content between individuals at rapid speed, they complement rather than supplant the need for information sharing through face-to-face social interaction. Tacit knowledge transfer demands the latter. Such knowledge is "defined by social context" and often developed through methods such as a "group-based problem-solving exercise" (Gertler 2003, 78). Regions with highly-developed networks of tacit knowledge production and diffusion gain a competitive advantage in the globalized economy (Zook 2004b).

One way that regions can harness their intellectual capital of tacit knowledge is by applying such knowledge to infrastructure improvements. Infrastructure development and maintenance may suffer from a perception of stasis and irrelevance, but are actually highly dynamic concepts intertwined with social relations (Parks and Starosielski 2015, 9). The process by which community-funded broadband expands in scale and capacity to compete with investor-owned systems is an example of a theoretical construct known as a socio-technical transition. This concept is an intellectually informed but practically relevant framework similar to the principle of social constructivism. Socio-technical systems encompass the means by which the "production, diffusion, and use of technology" is guided by "human actors embedded in social groups" (Geels 2004, 901). Some models of media infrastructure development resemble a layer cake, in which social and organizational factors form a trivial veneer at the highest and least relevant layer (Dourish 2015, 187). However, a breadbasket is a more accurate culinary metaphor; while technology may comprise the most visible components of an infrastructure system, decisions made by human actors are the metaphorical yeast that allows such systems to build out in material form.

Socio-technical systems include both technological aspects of infrastructure, as well as individuals working within an organizational context (Baxter and Sommerville 2011). "Place-specific impacts" influence these actors as they understand and manage transitions, providing a lens by which the discipline of geography can analyze socio-technical system development (Coenen, Benneworth and Truffer 2012, 4). Such systems evolve in response to selection pressures. Socio-technical selection pressures include quantitative macroeconomic factors, as well as qualitative cultural attitudes and trends (Smith, Stirling and Berkhout 2005). For instance, a case study of information services operated by Southern California municipalities showed that "the choice of technological paradigm" was primarily influenced by the "background and professional training of the developers" (Graham and Marvin 1996, 109). Public policy clearly inscribes technology. Even the realm of cyberspace faces political questions as venerable as Aristotelian philosophy: "who holds power, whose interests are served by the power holders, and how these power holders are to be made accountable" (Mitchell 1997, 152).

"Coalitions of social interests" including both business and policy leaders control infrastructure systems within municipalities (Hodson and Marvin 2010, 478). Utilities are key components of sociotechnical regime constructors (Smith et al. 2005). Lawhon and Murphy identified the need for “policy-makers, technologists, consumers, entrepreneurs, (and) civil-society organizations” to “redirect a regime and the systems it is part of toward a more socially … sustainable direction” (Lawhon and Murphy 2012, 359). For instance, Graham and Marvin posit that “the protection of marginal … consumers from ‘social dumping’ is a major concern that needs to be addressed by city governments” (Graham and Marvin 1996). Competition, such as that created when consumers can choose between municipal and investor-owned networks, is a form of sociotechnical selection pressure. Greater levels of competition are necessary in the American information utility sector due to the rapid consolidation through waves of mergers that occurred in the late 20th-century period of deregulation.

Such competition is lacking in many regions served only by investor-owned Internet utilities. These selection pressures are a key driver of overall regime change (Geels and Schot 2007). Actions taken at the local level can dramatically alter the function of the entire sociotechnical regime by destabilizing shared cognitive routines among leaders, altering regulations and standards, reshaping lifestyles adapted to previous technological systems, and prompting a shift in investment capital to new forms of machines and competencies (Geels and Schot 2007). Freight delivery company UPS once advertised that its core competency was ‘moving [packages] at the speed of business.’ As the speed of global capitalism accelerates, information utilities must ensure that they can distribute symbolic content at a concordant pace in order for the communities they serve to remain competitive.

1.5 - Rural Revitalization

The Internet promises a diverse array of benefits for development and competitiveness in rural areas, a summary of which I will present here. Grimes recognized that digital information and communications technologies could result in geographic change through "the development of a new layer of spatial relations … determined by networks of interconnected nodes" (Grimes 2003, 179). To connect with such networks, residents of low-density communities must have access to broadband. For example, small-to-medium enterprises (SMEs) can utilize high-speed Internet to gain access to customers around the world. Even large enterprises, such as those in the FIRE (finance, insurance, and real estate) sectors, use ICT to restructure production processes in ways that reduce their dependence upon locations in major metropolitan areas (Graham and Marvin 1996). As early as the 1930s, 'Chicago School' urbanists realized that analog forms of electronic communication, such as radio stations and telephone lines, allowed urban economies and lifestyles to interact with their rural counterparts more easily (Wirth 1938). For decades, the city has served the function of overcoming time by compressing space, while telecommunications technology has served the function of overcoming space by compressing time (Graham and Marvin 1996). Today, digital forms of ICT have only accelerated the compression of space by time that facilitates the dispersion of urban amenities to peripheral regions (Graham and Marvin 1996). For example, seven counties of Appalachian North Carolina have applied the comparative advantages of local government incentives and easily accessible infrastructure to become a data center corridor, hosting information infrastructure operated by Google, Apple, Facebook, and other major firms (Holt and Vonderau 2015).

Max Weber identified "'acquisition classes'" as a key component of socioeconomic stratification. These are delineated based on the "skills and services individuals can offer on the market" (Witte et al. 2013, 68). People with access to broadband service can learn more and higher-value skills, and accordingly offer more and higher-value services, than those without broadband access. For instance, many organic farmers have responded to customer concerns regarding socially responsible production by using Internet tools to increase supply chain transparency. These farmers can gain access to a wider variety of premium retailers due to the ease by which the safety, quality, and sustainability of their value-added commodities can be verified (Kitchin and Dodge 2011). Additionally, digital technologies can help users apply their skills in the workforce by providing networking and career-search platforms, such as LinkedIn and the U.S. Department of Labor's American Job Center. that boost social capital (Witte et al. 2013). Through these methods, broadband can help empower its users to build multifaceted human capital and achieve social mobility.

Internet-enabled commerce can help promote the sustainability of rural regions. While sustainability is commonly thought of in the context of environmental protection, social and economic development composes two of the three pillars of sustainability as defined by the United Nations Brundtland Commission (1987). For a community to be truly sustainable, its economy must be able to "provide the population with an adequate quality of life … without requiring substantial transfers from more prosperous regions" (Copus and Crabtree 1996, 41). This endogenous model of rural economic development, in which small-to-medium enterprises (SMEs) find success by using ICT to serve clients outside local markets, gained theoretical prominence in the European Union during the 1990s (Malecki and Moriset 2008). Yet, the current "diffusion of … the Internet … overlays existing economic geographies, adding even more protection to the urban core's privileged position" (Purcell 2016, 140).

In addition to accelerating economic development, ICT can facilitate the provision of foundational public goods and social services. Software-enabled networked systems have gained such a level of spatial and societal omnipresence that they have been dubbed "everyware" (Kitchin and Dodge 2011). Educational institutions have adapted to the cognitive-cultural era by shifting the delivery of instruction to novel and engaging venues empowered by unprecedented capacities for spatiotemporal compression. Early forms of distance learning delivered course material in a dramatically asynchronous format; instructors often broadcast lessons using radio or television systems, while students returned course material using postal correspondence. Today, teleconferencing allows for virtual face-to-face discussions between instructors and pupils, and podcasts allow lessons to be distributed on a global scale (Cejda 2007). Libraries no longer simply warehouse and catalog information, but have entered the digital 'space of flows' by offering instant online content search-and-retrieval tools akin to "information-brokering services" (Mitchell 1997, 69).

While education is a relatively visible and successful application of digital technology to bridge distance, other rural community functions also benefit from advanced ICT. The Obama Administration's Affordable Care Act facilitated the purchasing of subsidized health insurance plans through online exchanges. Once citizens gain access to health insurance, ICT often helps deliver their care. Rural areas in both developed and developing nations suffer from a shortage of health care providers; in the U.S., rural regions home to 20% of the population host only 9% of physicians (Grobler et al. 2009). However, through the use of Internet-based telemedicine, health care professionals in urban areas can examine patients in rural areas and provide specialized advice to rural care providers when necessary (Hudson 2005). Medical diagnostic devices often output observations in the form of digital data streams that can be transmitted for analysis in distant locations (Hudson 2005).

Broadband access can also help foster intergenerational social sustainability in rural communities suffering from population loss. Online social networks can augment community involvement among rural youth (Ei Chew et al. 2011). They can also help marginalized rural residents, such as members of the LGBTQ community, express themselves and build unique but contextualized identities (Gray 2009). In the words of Mitchell, "representation on the Net is not an inevitability of biology, birth, and social circumstance, but a highly manipulable … intellectual fabrication" (Mitchell 1997). In a broader sense, ICT allows people to associate with those who share interests rather than simply location (Graham and Marvin 1996). It helps social relations evolve from the *Gemeinschaft*, or place-based network of convenience, to a national and even global *Gesellschaft*, or choice-based network of shared interests (Kitchin 1998). Better-developed social networks can have practical benefits, such as improving disaster warning and resiliency, in addition to affective benefits (Castells 2004). Criminal activity can disrupt social relations, but even law enforcement utilizes advanced ICT. Some low-level offenders avoid incarceration through the use of electronic transponders, which alert a monitoring station if a spatial boundary is exceeded (Kitchin and Dodge 2011). Online regulatory databases, such as the EPA's Toxic Release Inventory, allow citizens to monitor hazardous chemical activity and environmental violations.

The social organization of cities has long represented a unique engine of creativity and innovation. However, while cities are crucial control points for information and capital flows, they do not hold a monopoly on novel ideas. Some rural areas, which lack the benefits of agglomeration economies and urban cultural amenities, have evolved out of necessity the capacity for surprisingly dynamic modes of thinking. Predominantly rural states in the Western U.S. were the first to grant suffrage to women during the late 19th century. Western economic conditions often required members of both genders to take part in production tasks, and rural development policy measures like the Homestead Act and Morrill Land Grant Act provided opportunities for women to own land and attend college (McCammon and Campbell 2001).

Despite common perceptions, some rural regions are actively engaged in ICT innovation ranging from digitally enabled organic farms to capital-intensive 'server farms.' During the early 20th century, agricultural cooperatives constructed ad-hoc 'wildcat' telephone systems from mail-order parts in order to reach areas underserved by major corporations. These systems, some of which used barbed-wire fences as transmission lines, were so successful that rural Americans were more likely to own a telephone that their urban counterparts in the years before 1920 (Sandvig 2006). Today, data storage centers, commonly known as 'server farms,' illustrate a contemporary advantage for rural areas in some forms of technological development. These facilities, which enable popular 'cloud computing' platforms, are frequently located in remote areas where land, power, and labor costs are low, rather than in major metropoles (Malecki and Moriset 2008). These advantages are key due to the significant spatial footprint of data centers, which can stretch across a space equivalent to two American football fields (Malecki and Moriset 2008). 'Server farms' offer careers with exceptional pay and advancement opportunities, but can only locate in areas with sufficient Internet connectivity.

If harnessed to empower peripheral communities, broadband Internet can play a key role in challenging rather than simply reproducing or accelerating entrenched core-periphery divides. Scott described how the modern era of cognitive-cultural capitalism places a premium on the symbolic and informational aspects of products (Scott 2011). To maintain competitiveness and relevancy, rural regions must harness local infrastructure and capabilities to access global information flows. Otherwise, the industrial-age patterns of disinvestment that marginalize isolated regions will continue for further generations.

Wikis, social media platforms, and other ‘killer apps’ of Web 2.0 empower users at the grassroots level to shape online discourse and participate in media creation to an unprecedented degree (Kitchin and Dodge 2011). Collectively and individually, users guide the development of technological structures in accordance with their needs, values, interests, and pre-existing social systems (Castells 2005). Advanced technology is “necessary but not sufficient” for the development of innovative social networks and governance institutions (Castells 2005, 3). Public sector planning and management performs similar guidance and control functions for communications infrastructure as software applications do for computing machinery. To overcome their digital divide, peripheral communities would benefit from a ‘Web 2.0’ of governance, in which public-service institutions rather than privately owned monopolies literally and figuratively construct the material infrastructure of cyberspace.

2 - Un-Dividing the Information Highway with Municipal Broadband

Digital divides are multifaceted issues that serve as a bridge between local capacities and global scale. Entire books explore the complexities of uneven digital development. I will focus on the United States. Although Internet access has risen markedly in recent years, this one-dimensional figure does not capture the differences in how the experiences of connectivity differ across the diverse fabric of American communities. Studies of broadband penetration represent “first-order” analyses of digital divides (Tseng and You 2013). However, just as Web 1.0 has given way to the interactive Web 2.0, “second-order” explorations of digital divides have shifted research foci toward uncovering more nuanced variations in level of Internet access and participation (Tseng and You 2013). Now, communities could further benefit from research regarding structural solutions to these divides.

2.1 – Public Sector Power

Municipal broadband provision is one such framework. Municipal broadband systems, or those owned and operated by a town government rather than a private company or non-government cooperative, have great potential to improve quality of service and social equity for millions of Americans. Such governments can help "serve … forgotten" groups of users by choosing to "experiment and pioneer systems that meet local needs" (Sandvig 2006, 505). Municipalities are uniquely well-positioned to provide broadband access due to their existing ownership of right-of-way and experience in providing utility services (Bar and Park 2006). For instance, large municipal utilities have developed some of the most innovative demand-side-management (DSM) strategies in the electric power industry (Wilson et al. 2008). The convergence of multiple types of infrastructure and services under a mutual framework reduces the cost and environmental impact of service provision (Camci et al. 2012). Infrastructure components that share right-of-way and patterns derived from common management practices often take the form of a technological palimpsest over time (Mattern 2015). The plethora of technologies used for municipal broadband shows that the creative aptitude of municipalities transfers readily from electric utilities to broadband utilities.

The major gateway factors to establishing a municipal network are the presence of a municipal electric utility and the creation of an intranet for municipal employees. For municipal electric utilities, fiber connectivity is an attractive value proposition because it can provide outage and maintenance information, as well as generate additional revenue (Walton 2014). Walton quotes grid reliability expert Ben Kellison: "(Broadband) service in larger cities tends to be at least competitive, but for someone who is in western Kansas, these opportunities may not exist." Large cities often contain high densities of affluent customers, prompting a variety of providers to enter the marketplace and compete for their business by offering fast speeds at low prices. However, rural areas often lack attractive levels of customer density, reducing the choice and capacity of available Internet services.

Community-wide broadband systems often begin as small-scale systems limited to municipal operations. Before being expanded, these systems improve communication within city departments, such as public safety, hospitals, and libraries, and are used for SCADA (Supervisory Control and Data Acquisition Systems) at power and water plants (Kelley 2004). For instance, Chattanooga's highly successful municipal broadband network originated from an effort to connect 'smart meters' used by that city's electric utility (Littlefield 2014). A White House report noted that the resulting 'smart grid' reduced the duration of power outages in Chattanooga by 60 percent, saving local businesses $45 million (2015a). 'Smart meters' also improve the cost-efficiency of utility operations by reducing the significant labor costs associated with manual meter reading (Graham and Marvin 1996)

2.2 - Nuts and Bolts

Throughout their construction and evolution, broadband networks take forms as diverse as the communities they serve. Different systems present unique pros and cons that can impact decision-making. Residents of metropolitan Kansas City can gain access to gigabit-level speeds by connecting to the privately owned Google Fiber network. Fiber systems possess the greatest speed capability of any existing broadband technology. On the other hand, Brooklynites who survived Hurricane Sandy in 2012 quickly restored connectivity using a wireless "mesh network," which avoids a central ISP altogether (LaFrance 2014). Terrestrial fixed wireless networks, which utilize base stations mounted on existing civic assets such as streetlights and traffic signals, provide an especially cost-effective means of providing service (Mandviwalla et al. 2008). As they require no trenching or cable installation, these systems reduce the barriers to entry for municipalities interested in entering the broadband provision space (Lehr, Sirbu and Gillett 2006). However, such wireless systems, including their terrestrial fixed, terrestrial mobile, and satellite-based variants, currently lack the groundbreaking speed capabilities of their fiber optic counterparts. Limited download speeds, inconsistent service reliability, and high levels of data lag could hamper the prospects of rural communities dependent on mobile wireless connections (Helper 2014).

Like the development of the telephone infrastructure in the early 1900s, current patterns of innovation in broadband Internet infrastructure are fast-paced, chaotic, and often practiced in forms independent from traditional institutions (Sandvig 2006). Entrenched telecom monopolies may challenge publicly created systems, but these innovative networks are rapidly expanding and already have an established record of sustained success. In addition to 'WiFi' (Wireless Fidelity) systems, 'FiWi' (hybrid Fiber-Wireless) systems have the potential to reduce costs even further by consolidating independent systems. Plastic optical fiber (PON) could enable deployment of fiber in brownfield settings due to its physical flexibility, high contaminant tolerance, and low cost (Maier, Ghazisaidi and Reisslein 2009). Another form of recycling that can enhance broadband provision is the promising use of gas mains as superstructure for fiber-optic cable systems (Camci et al. 2012). Micro-trenching, a method of burying fiber cable at shallow depths using an advanced narrow-blade soil cutter, could streamline the fiber installation process by reducing cost, environmental impact, and level of disruption to neighboring properties (Vaseli 2015).

2.3 - A Legacy of Leadership

Broadband technologies may be relatively new, but government partnerships are a proven way of expanding utility access in rural areas. For example, public-sector efforts promoted rural electrification in the early 20th century. During the 1930s, the Rural Electrification Administration provided federally-subsidized loans equivalent to 0.3% of the national GDP, which helped double the number of farms receiving electric service in just five years (Kitchens and Fishback 2013). Today, public-sector broadband utilities could meet the education, health, and economic development needs of 21st-century communities. Rather than shutting out private providers, they create an additional choice that stimulates competition in the broadband provision space. This leads to reduced prices, improved connection speeds, and greater rates of customer adoption (Lai and Brewer 2006).

The very genesis of the Internet reveals the value of public-sector engagement with technological innovation. Kitchin notes the ironic state in which "the Internet has largely been created with public money … [but] its current design largely limits access to those with…suitable private incomes" (Kitchin 1998). For instance, ARPANET, the system that eventually evolved into the modern Internet, was created using defense-related federal research and development funding (Mowery and Simcoe 2002). ARPANET began as an exclusive venue for scientists conducting military-related research, but rode successive waves of investment and expansion to serve a wider community of civilian users at public universities and laboratories.

The advent of the transistor made possible the development of the computers that comprised ARPANET – and today's networks. AT&T's Bell Labs developed this revolutionary technology in the late 1940s, and was forced to share it with upstart firms by the Federal Trade Commission under the terms of an antitrust suit (Lynn 2013). The development of innovative local networks through public-sector investment continues a long and fruitful legacy of government involvement in ICT deployment.

It is worth noting that private firms, such as Google Fiber, can also play a role in stimulating Internet development. Yet, municipal governments can partner with such firms by implementing policies that pave the way for private-sector actions. High franchise fees, or license costs charged to a private utility by a municipal government in exchange for access to a local market, can inhibit competition among Internet service providers (Szoka, Starr and Henke 2013). Other regulatory barriers include fees for right-of-way construction and utility pole access (Szoka et al. 2013). By streamlining the right-of-way permitting process to prioritize overall community investment rather than short-term revenue, cities can facilitate a competitive broadband marketplace (NCC 2015). However, communities can face challenges, such as refusal to grant pole access from incumbent providers, when working solely with private utilities. One of the most powerful ways for communities to secure an independent and sustainable digital future for their citizens is to invest in a publicly-owned broadband utility.

2.4 - Promoting Prosperity

Attracting new firms and generating increased revenue are two key goals for municipalities who implement broadband networks (Bar and Park 2006). The scope of empirical data linking municipal broadband to economic development is limited due to the relative novelty of municipal broadband and the small number of existing case studies. However, current research suggests a promising trend. For example, increased rates of per-capita economic activity seen in Lake County, FL compared to state peers were linked to the deployment of an extensive fiber optic network by a municipal utility within the county (Ford and Koutsky 2005). Between 2002 and 2005, economic activity in Lake County grew at 0.52% per month, compared with 0.29% per month in comparable Florida counties. Gross retail sales, one of the most important indicators used by economists to estimate overall market trends, served as a proxy to facilitate measurements of economic activity (Ford and Koutsky 2005). Lake County also experienced higher rates of population growth, which may be linked with municipal broadband implementation. However, statistical analyses showed that even if all population growth is conservatively assumed to be unrelated to municipal broadband, Lake County's increased economic growth was not simply an effect of population changes (Ford and Koutsky 2005).

Beyond the narrow measure of retail activity, municipal networks foster broader social equity and economic opportunity. Counties that gain access to broadband enjoy an average 1.8% increase in overall employment, with even larger gains seen in rural areas (Atasoy 2013). The Chanute, KS network generates over $600,000 in revenue each year to support municipal operations (Porter 2013). The economic development benefits of municipal networks are a particularly promising indicator for their diffusion, as many neoliberal-era municipal leaders have a favorable view of using municipal resources to foster the creation of wealth through private enterprise.

Chattanooga's high-speed network is an exemplary case study for the ways in which municipal 'power and light' utilities can empower and enlighten communities by expanding their service portfolio to include broadband Internet. It has fostered the growth of several technology startups, as well as venture capital firms. Many such firms consider broadband capacity to be a key factor when making location decisions (Lobo 2015). Cloud-computing companies such as Claris Networks, as well as telecommunications-intensive firms such as HomeServe and Bellhops, use the system as a cost-effective backbone for their local technical infrastructure (Lobo 2015). In 2008, economists projected that the system would create $352.4 million in elevated economic activity and 2,600 new jobs by 2015 if deployed throughout Hamilton County, which includes Chattanooga (Lobo, Novobilski and Ghosh 2008). Since its network became operational in 2010, the former struggling textile town has in fact welcomed $1.3 billion in new investment and 6,800 new jobs (Remy 2013). Productivity gains as a result of the network's extraordinary capacity have saved local firms approximately $2,300 per commercial customer per year (Lobo 2015).

2.5 - Broadband vs. Narrow Minds: Creating Grassroots Internet Innovation

In addition to state and federal politics, data suggest that local management practices are a key determinant for whether or not a given municipality operates a broadband network. For individual user broadband access, the key factors include ethnicity, education level, and income (Warf 2010). However, broadband infrastructures are complex material systems that form at different scales (Parks and Starosielski 2015). As the scale of analysis changes from the individual scale to the community scale, the important broadband access determinants change accordingly. For instance, if the same factors that correlated with individual access applied to whole communities, high-income suburbs like Overland Park and college towns like Manhattan would have municipal networks, rather than Chanute and Ponca City. One reason for this difference is that current analyses of broadband access focus on demand-side variables, such as household income and computer skill level, rather than supply-side variables, such as number of available providers and speed levels. Therefore, they rarely differentiate between service provided by an investor-owned utility and that provided by a municipal network. Even the "Overview of the Digital Divide" section of the *Handbook of Research on Overcoming Digital Divides* contains no data illustrating proportions of users served by various institutional modes (Ferro et al. 2010).

The U.S. currently trails eight other countries in rankings of average Internet connection speed (Remy 2013). To address this deficiency, many leaders have made efforts to support municipal Internet. In 2015, President Obama stated his support for municipal networks, and declared his opposition to state laws that restrict municipal funding (2015b). Presidential candidate Hillary Clinton also declared her support for municipal broadband (Fung 2015b). In June 2016, the U.S. Court of Appeals for the District of Columbia Circuit upheld the FCC's definition of broadband Internet access as a Title II common-carrier public utility, rather than as an information or entertainment service (2016). While federal action represents a key step forward for municipal network implementation, the primary actors are located at the municipal and community levels. For instance, Bristol, TN's municipal network grew with the help of $21 million in bonds and federal grants, but only after being originally established for internal local government use (Null 2013).

Although beneficial for a given community, creating a municipal broadband network is not, in technology parlance, a simple 'plug-and-play' operation. A White House report shows that many U.S. states, including Kansas, have fewer than 10 municipal broadband networks (2015a). Chattanooga, TN only constructed its infrastructure after receiving a $111 million federal grant and issuing $170 million worth of municipal bonds (Rushe 2014). The risk paid off: as of July 2016, the network had twice as many subscribers as are needed to break even, and has become the largest single taxpayer in the city (Koebler 2016).

Chanute was able to avoid taking on debt by constructing its network through an incremental process funded by electric utility revenue, connection fees from local institutions, and a limited number of small grants (Gonzalez and Mitchell 2012). The initial buildout of Chanute's network was motivated by a Department of Homeland Security requirement for improved security measures, such as networked closed-circuit cameras, at public water supply systems. In 2015, Chanute considered adding an extensive fiber-to-the-home (FTTH) component to its system, and even obtained approval to do so from the Kansas Corporation Commission despite significant opposition from AT&T. However, this plan was postponed indefinitely due to the $19 million debt that would be required (Gonzalez 2015). Municipal utilities are advanced technological projects, but they depend upon adequate funding and enlightened leadership as much as light-speed fiber optic cables.

Political and entrepreneurial factors drive local Internet innovation, but can also present barriers and disincentives. For instance, advances in the municipal water utility sector are hampered by "institutional constraints" and "inertia in the … industry" (Kiparsky et al. 2013, 395). New innovations often diffuse more slowly among publicly-owned utilities than their larger corporate counterparts (Rose and Joskow 1990). Researchers have documented a trend in which "state or federal (utility) regulation … might manifest itself in very different ways depending on the institutional structures that shape the local politics" (Teodoro 2010, 101). Barriers to utility innovation are often made more severe by "institutional resistance to externally-generated information" (Rayner, Lach and Ingram 2005, 223). Governance structures are often imperfectly organized, and can lack vantage points from which to acquire new information and consider new perspectives (Kitchin and Dodge 2011).

History shows that those who work to establish municipal networks can face significant challenges. The 'Tech Boom' of the late 1990s and early 2000s sparked a great deal of exuberance surrounding municipal networks, much of which proved to be irrational. Philadelphia, for instance, granted private provider EarthLink an exclusive license to operate a wireless network in the early 2000s. This effort was, at the time, the largest such network in the U.S. in terms of number of users (Null 2013). However, due to an unwise planning and financing structure, this bold initiative soon collapsed. Rate and right-of-way restrictions established by the City prevented the network from turning a profit, which caused EarthLink to reduce the system's capacity, further reducing popularity and profitability. Ultimately, EarthLink abandoned the project and turned the system over to the municipal government (Null 2013). This case study shows that effective and farsighted public policy, in addition to advanced technology, is necessary to build a sustainable municipal network.

A relatively new additional challenge is the lobbying efforts of traditional investor-owned utilities, which have led some states to place restrictions on municipal-government-funded networks operating within their borders. For example, Chattanooga has reaped extraordinary benefits from a gigabit-speed network operated by its municipal electric utility EPB. However, the neighboring state of North Carolina has effectively "barred municipal networks from the consumer market" (Stricker 2013, 591). North Carolina's action forced the gigabit-speed utility serving the town of Pinetops to cease connection, leaving the town with no broadband access whatsoever (Gonzalez 2016). Following a multi-million-dollar lobbying effort by AT&T, Charter, and Comcast, Tennessee also passed a bill protecting investor-owned utilities from competition by prohibiting cities with such utilities from establishing municipal broadband (Holmes 2014). In rural communities near Chattanooga but outside of EPB's service area, parents report having to drive their children to McDonald's, which offers free public WiFi at many franchises, in order to access sufficient connectivity for completing online homework assignments (Vara 2015).

While Kansas law does not currently restrict municipal broadband, the threat of such action is still felt within the state. In 2014, the Kansas Cable and Telecommunications Association, a lobbying group for private telecommunications providers, authored a bill that would have prohibited municipal broadband. The bill was introduced in the State Senate, but was defeated after facing significant opposition from the public (Teters 2015). In neighboring Missouri, AT&T donated over $62,000 to political campaign committees in advance of the state legislature's consideration of a bill restricting municipal broadband (Brodkin 2016a).

2.6 - Building Upon Local Capacities

President Obama has compared the results of municipal broadband network creation to "unleashing a tornado of innovation" (2015b). A former mayor of Chattanooga has compared his city's position in the burgeoning digital age to "'being the first city to have fire'" (2015b). Broadband Internet access is no longer a luxury, but rather an essential component of public infrastructure. Purchasing health insurance, applying for admission to college, and reading e-textbooks are just a few of the modern tasks that make network connectivity necessary for social reproduction and human capital creation (Kitchin and Dodge 2011). Retailers operate as nodes in an information web that manages supply chain functions, and thus depend upon networked software in order to earn revenue and provide communities with products (Kitchin and Dodge

2011). A legion of crucial devices in the Internet of Things, ranging from medical monitors to banking systems, also depend upon such software to function.

To improve quality of service and promote social equity, municipalities can play a key role in operating high-performance and cost-effective broadband systems. Technological innovation, especially at the societal level, does not occur in a vacuum. The perspective of municipal administrators provides insight into the local political and managerial factors that foster or inhibit Internet innovation. By making decisions regarding network technologies and policies, these leaders serve as crucial links between the individual user scale and the global network scale. Richard Florida describes how "the most important policy innovations come from … cities and mayors crafting pragmatic … solutions to pressing social and economic problems (Florida 2014, 395). Municipal governments command higher levels of citizen trust compared to their national counterparts, as such governments can relate both to transnational capital flows and the interests of local citizens (Castells 2004).

In the words of Silicon Valley activist Sonja Trauss, "'Even in this modern era of … the Internet and people … interacting in a place that's no place at all, City Hall is still a center'" (Dougherty 2016). Darden Rice, chair of the City of St. Petersburg, Florida's Sustainability Committee, describes local innovation in the post-welfare-state era using the metaphor "'There is no [federal] cavalry left. We are the cavalry. It's up to [municipalities] to be the agents of change … in a practical way'" (Geiling 2016). While advances such as high-speed wireless connectivity can help make networks more cost-effective and successful, local leadership is essential for creating systems that empower communities through technological change. Technology is not an asocial force that determines the course of history, but is rather a human-centered endeavor inscribed upon – and proscribed by – local political and social structures.

2.6 - The Kansas Landscape

My first decision before beginning data collection and analysis regarding such structures was to define an appropriate geographic scale for my research. Scale consists of interactions among defined processes and places, and has three main elements: place, actions, and a relational dimension that serves as a link between places and actors (O'Lear 2010). Infrastructure analysis occurs at a multitude of scales, including “corporeal, local, urban, regional, national, and international” (Mattern 2015, 107). The form of scale which describes governance institutions, such as municipalities or nations, is known as administrative scale, while the form of scale that defines the extent of a study area is known as observational scale (O'Lear 2010). This project combined the two by focusing on the local political and social structures within the U.S. state of Kansas. While human activity often generates connections beyond administrative boundaries, administrative scale can be a useful starting point for understanding human activity, especially relationships between particular actors guided by particular sets of values and goals (O'Lear 2010). For instance, Guthrie and Dutton’s analysis of public information utility development during the early 1990s focused exclusively on case studies within the state of California (Guthrie and Dutton 1992).

White House estimates identify only four municipalities in Kansas with municipal broadband networks: Chanute, Lenexa, Ottawa, and White Cloud (2015a). The state provides a unique context through which to study digital geography. Google Fiber, a privately owned fiber optic utility, provides gigabit-speed Internet access to the Kansas City metropolitan area. This service has facilitated the creation of startups, but falls short of providing universal service. Its implementation followed pre-existing neighborhood delineations and reproduced some historic inequalities (Halegoua 2015). In some of Kansas City’s inner-city neighborhoods, 20% of residents lack Internet access (Morris 2015). Google Fiber and the two other competing providers offering gigabit service in Kansas City have expanded to suburban communities within the metropolitan area. However, the deployment patterns of this groundbreaking Internet innovation serve as a microcosm for the increasing stratification between American urban and rural areas. Just a few hours' drive from Kansas City's startup incubators, fiber-connected condominiums, and other hubs of cognitive-cultural capitalism lie peripheral areas struggling for sustainability in the Digital Age.

Apart from 'Smallville USA' clichés, the state of Kansas exemplifies rurality in many ways within the American geographic imagination. Its population density is just 35.6 persons per square mile, a level classified as "Densely-Settled Rural" by the Kansas Department of Health and Environment (Hurd, Mercer and Wedel 2016). The "plains of the US Middle West" are considered a representative monotonous landscape unlikely to attract creative class workers on the basis of amenities. For decades, Kansas license plates declared the slogan 'Midway, U.S.A.' as the geographic center of the contiguous United States is located in northern Kansas. This creates a unique interaction with the digital landscape. A ranch near this central location serves as the default coordinate for an IP address location tool used by over 5,000 companies and law enforcement agencies. As the database automatically assigns this coordinate to any untraceable address, over 600 million IP addresses – often used by scammers, computer thieves, and suicidal individuals in contact with anonymous help lines – are now associated with this location. This has caused considerable disruption for the resident family, who, ironically – and tellingly – rarely uses the Internet (Hill 2016).

Apart from this eerie example of convergence between digital and physical landscapes, most Internet challenges experienced by rural Kansans are the more prosaic 'Information

Highway' roadblocks familiar to many rural Americans. As of 2013, 24.6% of Kansans lacked Internet access (Hurd et al. 2016). While many choose not to subscribe to Internet services, Internet accessibility is shaped by broader social and economic factors beyond mere individual choice. For instance, 5.4% of Kansans are not served by any wireline Internet providers, and 13.4% are only served by one wireline ISP (2014). A majority of Kansans (52.0%) can only choose between two available ISPs (2014). While 36.9% of Americans overall are served by three Internet providers, only 11.4% of Kansas have this number of competing choices available in their communities. Only 19.9% of Kansans have access to the fiber optic infrastructure (2014).

Kansas network performance reflects these technological and economic limitations. The median download speeds for homes and businesses in Kansas are both less than five Mbps, and the median upload speeds are both less than 3 Mbps (2014). 25% of schools, libraries, and community centers access the Internet at download and upload speeds of less than 5 Mbps. Wireless technology is the only type of Internet infrastructure accessible to 100% of Kansans, but the median download and upload speeds for mobile Internet connections are 1.2 Mbps and 0.6 Mbps, respectively (2014).

3- Data and Methods

3.1 - Survey Development

Many of my research questions focus on the experiences, perceptions, and actions of municipal leaders in Kansas. Therefore, I chose surveys as my primary data collection method. Surveys are an effective means for gathering qualitative data regarding the attributes, behaviors, attitudes, and beliefs of a group of individuals (McGuirk and O'Neill 2010). The potential for surveys to be counted, cross-tabulated, and statistically analyzed provides an additional semi-quantitative dimension that enhances their power as a research tool (Winchester and Rofe 2010). Surveys provide insight into relevant trends and patterns, are cost-effective to distribute, and are highly flexible, especially if conducted online (McGuirk and O'Neill 2010). The ability of electronic surveys to gather data from respondents across a wide geographic area is particularly important, considering the vast distances that often separate rural Kansas towns. Additionally, questionnaires facilitate the collection of detailed data by providing respondents with the time necessary to develop answers to unfamiliar or complex questions (McGuirk and O'Neill 2010).

I developed the survey instrument strategically in order to maximize data collection capacity while minimizing difficulty and time commitment for potential respondents. In accordance with best practices, I conducted a pre-test with a sub-sample of my target population before distributing the survey to a wide audience (McGuirk and O'Neill 2010). The results of this test informed my decision to place all prompts on a single page when creating the main survey. This format helped prevent respondents from exiting the survey prematurely due to a failure to notice the arrow symbol that would allow them to navigate to the next page. Additionally, I added a question that allowed respondents to provide their perceived definition of ‘municipal broadband’ to promote specificity and consistency. All questions use nominal variables, with the exceptions of #17 and #18, which use ordinal variables. I employed both rating and ranking questions. In keeping with good research practice, I avoided questions that were ambiguously worded, as well as leading questions (Kelley et al. 2003). Respondents could specify concepts using open-ended text prompts. In order to maximize the response rate among busy officials, I provided an open-ended opportunity for constructive criticism (Nulty 2008). Additionally, I limited the length of the survey, as survey length is negatively correlated with response rates (Fan and Yan 2010).

3.2 - Implementation

My primary dataset derives from a survey of municipal officials in 220 communities across Kansas and other states. Surveys are an effective means of gathering data from a diverse array of municipal leaders (Opp and Saunders 2013). My contact method consisted of a two-stage process involving telephone and email outreach. I used the Qualtrics platform to create and distribute the electronic version of the survey. Qualtrics allows for the incorporation of encoded skip patterns. These facilitate the use of more complex questions, and provide the ability to gather segmented data from communities with distinct characteristics (McGuirk and O'Neill 2010). I distributed the survey by sending it to the email addresses of municipal officials listed in the League of Kansas Municipalities directory. I selected communities for potential participation randomly from this directory. I also obtained publicly available email addresses from staff directories listed on municipal websites. Officials who provided useful information included information technology directors, city managers, city planners, and city clerks.

Due to the low response rate and high cost, l chose not to use postal mail as a contact method. Even among studies based exclusively on electronic surveys, low response rates are common in an era of excessive spam and widespread concerns about cybersecurity (Fan and Yan 2010). Competing demands on potential respondents' time, as well as Internet connectivity challenges in peripheral areas, can also inhibit response rates (O'Lear 1996). To maximize the response rate, I contacted each community who did not complete the electronic survey via telephone. I used the Skype voice-over-IP platform to make telephone calls. Ultimately, 38 communities provided responses, resulting in an overall response rate of 17.3%.

3.3 - Analysis Methods

My analysis is inspired by applied people's geography, a framework in which the tools of geographic analysis are used both to advance the state of the academic field as well as to serve broader social purposes for the communities in which research is conducted (Howitt and Stevens 2010). I processed my dataset using both quantitative methods, such as descriptive statistics, as well as qualitative methods, such as coding. My goal was to create a stable platform for sound conclusions using the 'three-legged stool' of descriptive statistics, inferential statistics, and qualitative analysis. Codes correspond to the key themes emphasized by qualitative methods literature: conditions, interactions among actors, strategies/tactics, and consequences (Cope 2010). I used analytic codes to process the response data. Such codes "reflect a theme" of interest and "dig deeper into the processes and content of phrases or actions" (Cope 2010, 283). Codes are intended to connect raw data from practical settings with "the theoretical framework of the study" (Cope 2010, 285). I used codes specifically to categorize responses associated with the research question 'What are municipal leaders most interested in learning about municipal broadband?' Six codes best fit this purpose; these codes comprise my codebook. A codebook is a foundational list of codes that are categorized and organized based on repeated usage and proven utility (Cope 2010).

In addition to coding, I analyzed qualitative data using CAQDAS (Computer-Assisted Data Analysis Software). Computer-assisted qualitative data analysis is based upon interactions between the researcher, the research process, and the particular hardware and software tools used (Peace and van Haven 2010). One of the key features of such software is the ability to identify and select particular words of phrases that comprise incoming responses. To perform these word search operations, I used the NVivo software platform. Computer-based data analysis does not simply replace manual techniques, but allows researchers to discover new pathways for interacting with datasets (Peace and van Haven 2010). For instance, NVivo allowed me to create a 'word cloud' in order to display my data in an accessible and engaging format.

Statistical analysis provided another opportunity to utilize software-based research tools. I primarily used the IBM SPSS software package to process data and generate reports. Chi-square and analysis-of-variance (ANOVA), as well as comparison of mean and median values, comprise the key statistical processing methods. These are optimal for the categorical, "Likert [Scale]-Type" data provided by respondents (Boone Jr. and Boone 2012). I set the threshold of statistical significance at a p-value of 0.2. This indicates that the likelihood of a given result occurring by random chance is 20% or less (Bennett, Briggs and Triola 2014). 0.05 is generally considered the conventional level of significance (Nuzzo 2014). However, significance thresholds are subjective guidelines that exist within a project-specific context (Nuzzo 2014). Research using alternative thresholds can still yield valid and insightful results. With this in mind, I selected a statistical framework with utility for my findings.

When soliciting responses, I set a goal of obtaining at least 30. Thirty is the standard sample size threshold for valid statistical analysis (Bennett et al. 2014). Since I exceeded this goal, valid statistical analyses are possible for both the collective set of responses, as well as the subset of responses from communities without an MBN. This response rate enables generalizations regarding rural broadband, especially within a Kansas context. It is most effective at supporting generalizations regarding the research questions that focus on perceptions and plans among non-MBN communities. However, the small sample size of responses from communities with an MBN means that this subset is a better source of qualitative case studies than of inferential statistical conclusions. Additionally, due to the diverse and multiscalar nature of community planning, my inferential statistics results are best viewed through the holistic context of my descriptive statistics patterns and qualitative analysis. Just as the demand, use, and infrastructure of network technology emerges in different forms based on local context, my inferential statistics are not best suited to 'one size fits most' generalizations, but rather guidelines to a more informed understanding of technology's unique social construction.

Sample size and response rate are the primary limitations of my analysis. Response bias may pose an additional limitation, as managers who have limited initial familiarity with MBNs may be unlikely to participate in the survey. However, managers who have some existing knowledge are more likely to report accurate perceptions of MBNs in response to questions regarding predicted MBN implementation. In effect, responses are thus biased in favor of more credible and better-informed respondents.

3.4 - Secondary Data

Sources of secondary data include the U.S. Census Bureau American Community Survey (ACS) and the KMEA (Kansas Municipal Energy Association) directory. The former provided demographic and economic data, while the latter provided data regarding the presence or absence of a municipal electric utility in responding communities. Additionally, the *White House Report on Community Broadband* identified communities that already operate a municipal broadband network (2015a). While the definition of municipal broadband can vary based on the experiences of respondents, the White House report provides a consistent baseline from which to begin exploration in greater depth. I initially considered using municipal or metropolitan comprehensive plans as secondary data sources. However, such plans rarely incorporate ICT infrastructure. For instance, the City of Wichita-Sedgwick County's *2015-2035 Community Investments Plan* devotes one sentence of a 48-page document to the goal of "Develop[ing] and implement[ing] a community-wide, public and/ or private broadband infrastructure." The City of Lawrence's *Horizon 2020* comprehensive plan includes no mention of broadband infrastructure whatsoever in its 321-page entirety.

3.5 - Interview Methodology

Follow-up interviews can add depth to data collected via questionnaire (McGuirk and O'Neill 2010). Interviews help investigate complex actions and motivations, and facilitate the collection of a diverse range of information regarding events, opinions, experiences, and meanings (Dunn 2010). Therefore, I included a prompt in my survey that allowed respondents to enter their telephone number if they were interested in contact for a future interview. Two respondents indicated initial interest, and one ultimately agreed to participate in a telephone interview. To prepare for the interview, I created an aide-memoire, or semi-structured list of key discussion topics (Dunn 2010). I used both primary questions, which prompt discussion on an overarching concept, and secondary questions, which encourage respondents to clarify responses using additional detail (Dunn 2010). Main question formats included descriptive, opinion-based, and hypothetical contrast (Dunn 2010). The interview lasted approximately one hour and ten minutes.

3.6 - Community Characteristics

Secondary data helped me summarize the characteristics of responding communities. Institutional Review Board guidelines prevent me from disclosing their specific locations, but the responding communities are geographically well-distributed throughout the state. The median population is 2,688 (Table 1). This signifies that my survey was effective at focusing on rural communities. The U.S. Census Bureau classifies a community as "rural" if it does not fall within an urbanized cluster; an urbanized cluster requires a population of at least 2,500 (2015c). Exactly half of the responding communities had 2015 population levels below this threshold. The average five-year population growth rate of responding communities was -0.29 (Table 1). This may indicate that responding communities are disadvantaged due to their failure to retain residents. Responding communities have a median home value of $84,800 (Table 1). This low value indicates a limited base from which to draw property tax revenue. Property tax revenue is the essential source of funding for local government services such as public school systems, especially in the decentralized political environment of the U.S.

Table 1 – Community Characteristics

Variable	N	Median	Min	25th Percentile	75th Percentile	Max	Median (State of KS)
2015 Population Estimate	38	2,688.0	103	761.8	7231.5	389,965	2,911,641.0
2010 Population	38	2,830.5	111	750.8	7412.8	382,368	2,853,118.0
5-Year Population Growth (%)	38	-0.2%	-7.2%	-4.1%	3.2%	8.6%	2.1%
2014 Median Household Income ($)	38	$41,607.5	$27,232	$36382.8	$50,775.8	$81,622	$51,872.0
2014 Poverty Rate (%)	38	14.0%	2.9%	8.3%	23.5%	37.3	13.0%
2014 Median Housing Value ($)	38	$84,800.0	$29,000	$53,425.0	$134,400.0	177,900	$129,400.0
2014 High school graduate or higher (%)	38	90.4%	77.3%	87.0%	93.1%	98.6%	90.0%
2014 People of Color (%)	38	8.9%	1%	5.3%	14.2%	44.3%	21.8%
2014 Median Age	38	37.25	21	33.3	41.6	56.1	36.0

All of the responding communities are located in Kansas. Two operate municipal broadband networks (MBNs), while 36 do not (Table 3). The population growth rate, median household income, median housing value, and rate of educational attainment of the sample of responding communities were all lower than those of the state of Kansas as a whole (Table 1). The poverty rate of the responding communities is higher than that of the state of Kansas as a whole (Table 1). 35 of the responding communities receive electric power service from an investor-owned or cooperative utility, while three receive electric power from a municipal utility

(Table 2). One of the communities with an MBN operates a municipal electric utility, while the other receives electric service from an investor-owned corporation.

Table 2 – Utility Characteristics

Communities Served by Municipal Electric Utility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	35	92.1	92.1	92.1
	Yes	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

Table 3 – MBN Presence

Q3 – "Does your municipality own and operate a municipal broadband network?"

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	5.3	5.6	5.6
	No	34	89.5	94.4	100.0
	Total	36	94.7	100.0	
Missing		2	5.3		
Total		38	100.0		

Characteristics of responding communities influence the methodological context of my study. The large sample of communities without MBNs is an example of statistical generalization, while the small sample of communities with MBNs is an example of analytical generalization. In the former, transferability is achieved through sheer sample size, while transferability is achieved in the latter through the selection of useful cases and by developing resulting theories that are neither too abstract nor too specific (Baxter 2010). Multiple case studies are particularly beneficial, as they can corroborate findings and reveal broader theoretical constructs (Baxter 2010). Smaller sample size encourages idiographic research, which explores subjects in greater depth than its nomothetic counterpart (Baxter 2010). As a result, communities with MBNs completed a version of the survey that included both more questions and more detailed questions than the version completed by non-MBN communities. It is important to note that, although only two communities with MBNs responded to the survey, only approximately four communities operate such networks in the entire state of Kansas. Despite their limited sample size, case studies are an effective means of gaining insight into community planning and perception (Baxter 2010). In particular, the Social-Construction of Technology (SCOT) framework makes extensive use of case studies that describe the evolution of a technological system within a given social context (Graham and Marvin 1996).

4 - Internet Insights: Lessons Learned from Data Analysis

4.1 - Professional Knowledge Base

One of my key research questions is 'How do municipal managers learn about municipal broadband?' Many responding communities are located far from population centers, and have limited funding for professional development. Therefore, I hypothesized that popular media would be the most common means by which staff members learned about MBNs. However, "Professional Conferences" were in fact the most common venue for education. 42% of respondents selected this as one of their choices (Table 4). This finding corroborates qualitative results, as the interviewed manger described professional organizations such as Next-Century Cities (NCC) and Government Managers of Information Systems (GMIS) as useful facilitators of conferences and publications. Professional conferences are not just the most common source of knowledge; they are likely the most effective. A statistical correlation exists between the likelihood of learning about MBNs at "professional conferences" and the likelihood of planning to implement one in the near term (Table 34). None of the other knowledge sources was statistically associated with MBN implementation likelihood (Table 34). This indicates that an important synergy exists between both tacit and explicit knowledge, as both are more readily available through professional conferences than through non-interactive media. Additionally, professional conferences targeted at municipal managers and utility personnel may have a distinctly positive discursive orientation toward the capabilities of municipal institutions to accomplish complex goals such as MBN development.

The least commonly selected choice was "This Survey" (Table 4). This choice intends to identify managers whose first introduction to municipal broadband was the research information statement. Its low ranking indicates that many managers already had some familiarity with MBNs prior to receiving the invitation to take part in the study. However, it could also indicate a response bias, as managers who are completely unfamiliar with municipal broadband may ignore the participation prompt entirely. "Professional Media" was the third-most-commonly selected choice (Table 4). I was surprised at its relatively low ranking. Professional media sources, such as industry publications aimed at both investor-owned and municipal utility staff, have been helpful for advancing my own understanding of municipal broadband development in preparation for undertaking this project.

Table 4 – Existing Professional Knowledge Base

"Where have you learned about municipal broadband networks?"	**N**	**Selection #**	**Selection Ratio**
Job Training	38	12	31.6%
Popular Media	38	8	21.1%
Professional Conferences	38	16	42.1%
Professional Media	38	9	23.7%
This Survey	38	8	21.1%
Other	38	5	13.2%

Q1 - Where have you learned about municipal broadband networks? Job Training

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	26	68.4	68.4	68.4
	1	12	31.6	31.6	100.0
	Total	38	100.0	100.0	

Q1 - Where have you learned about municipal broadband networks? Popular Media

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	30	78.9	78.9	78.9
	1	8	21.1	21.1	100.0
	Total	38	100.0	100.0	

Q1 - Where have you learned about municipal broadband networks? Professional Conferences

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	22	57.9	57.9	57.9
	1	16	42.1	42.1	100.0
	Total	38	100.0	100.0	

Q1 - Where have you learned about municipal broadband networks? Professional Media

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	29	76.3	76.3	76.3
	1	9	23.7	23.7	100.0
	Total	38	100.0	100.0	

Q1 - Where have you learned about municipal broadband networks? This Survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	30	78.9	78.9	78.9
	1	8	21.1	21.1	100.0
	Total	38	100.0	100.0	

Q1 - Where have you learned about municipal broadband networks? Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	33	86.8	86.8	86.8
	1	5	13.2	13.2	100.0
	Total	38	100.0	100.0	

"Where have you learned about municipal broadband networks?" - Other
Kansas State University Dept. of Community Development and Planning
Internet
Next Century Cities
Seen in municipalities where I lived previously

Qualitative data shows that many leaders are motivated to further develop their knowledge and skills. 68.4% of respondents provided feedback regarding what municipal-broadband-related topics they would be most interested in learning more about. An overwhelming plurality provided responses indicating that they would be most interested in learning about best management practices for operating MBNs (Table 8). The second-most-frequently-mentioned topic was cost and financial concerns (Table 8). Words related to this topic comprised a 20-percent plurality of results in the text frequency analysis (Table 10). Potential benefits from MBNs, as well as legal implications, also were a popular topic of interest (Table 8). Many responses indicated that managers perceive small population size as an obstacle to municipal broadband implementation. For instance, one leader reported that they "live in a small community, and would love to see if it was cost effective on a small scale" (Table 9).

Topics related to MBN operations were prominent in reports of desired future knowledge. Since this topic category is highly heterogeneous, I conducted additional coding of these responses to clarify results. A plurality of operations-related topics of desired future knowledge corresponded to basic and abstract concepts (Table 11). For instance, the phrase "How they work and what is the best plan for the city to consider" epitomizes this category (Table 9). Many such responses only included one word. This pattern underscores the many competing demands for the time of municipal managers. It also highlights the importance of addressing basic MBN implementation topics at professional conferences and other knowledge sources. Eighteen percent of the operations-related topics reported as subjects of further interest involved whether or not an MBN would be feasible in the respondent's particular local context. In fact, local context was the second-most-commonly reported desired future topic of knowledge regarding MBN operations (Table 11). This is likely an important topic for education and outreach efforts, as MBNs have achieved successful results in communities of limited population size, in addition to large cities. It is important to address MBN misconceptions, such as the idea that small towns lack the capacity to create MBNs, through professional development sources. An organizing theme such as "MBN Mythbusters" may initially seem cliché, but could serve as a useful theme for MBN-related professional outreach.

Table 5 - Qualitative Analysis of Desired Future Knowledge (n=26)

Code	**Definition**	**Proportion of Answers**
BEN	Benefits of Municipal Broadband	11%
COST	Cost of Municipal Broadband	23%
OPS	Practices for Effective Municipal Broadband Operations	42%
LEGAL	Legal Issues Regarding Municipal Broadband Policy	8%
NO	Not Interested in Learning More About Any Municipal Broadband Topics	12%
UNI	Unique Answers	4%

Table 6 - Coding of Desired Future Knowledge Responses

UNI	The City has been looking into several options for several years.
OPS	Connecting to Tier 1 networks and managing access and peering relationships
OPS	how other cities our size, less than 2500 people, have addressed this issue.
OPS	How they work and what is the best plan for the city to consider.
OPS	How to make them operate efficiently
OPS	Implementation
OPS	Overcoming 'human' obstacles e.g. political, budgetary.
OPS	Statup
OPS	Use cases and partnership models.
OPS	Ways to get affordable gigabit broadband to every structure.

OPS	what options? deployment strategies? business case factors?
OPS	Whether our community is a good candidate to invest in a municipal broadband network.
NO	My interest in municipal networks ended when a local cable provider began an ongoing project to provide fiber through the community.
NO	No, we have a population of 3200 and the local telephone company offers broadband access
NO	Not interested.
LEGAL	Legality of establishment of Municipal System given the legislative climate of general opposition due to lobbying efforts of industry that already provides some "broadband" services to part of the State
LEGAL	Why state legislation now prohibits expansion of municipal systems
COST	Affordable, high speed internet
COST	Availability and operating cost.
COST	cost and benefits of a municipal system
COST	how cost effective they are
COST	I live in a small community, and would love to see if it it was cost effective on a small scale. I also would be interested in learning more about state laws. Changes at the legislature scare me in making this investment that may become illegal.
COST	What funding is available. We cannot fund locally.
BEN	How can they be beneficial to the City
BEN	I guess first I need someone to tell me why I should be. I might be interested to know how a community's internet speed relates to the busineseses they are able to attract.
BEN	value created or lost because of them

Table 7 - Word Frequency Analysis of Desired Future Knowledge Responses

Word	**Count**	**Weighted Percentage**
"community"	5	2.33
"city"	4	1.86
"cost"	4	1.86
"access"	3	1.40
"affordable"	3	1.40
"interested"	3	1.40
"networks"	3	1.40
"options"	3	1.40
"state"	3	1.40
"'human'"	2	0.93

Fig. 1 - Word Cloud of Desired Future Knowledge Responses

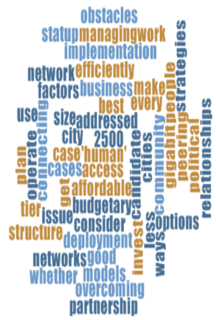
Table 8 - Qualitative Analysis of Reported Operations-Related Topics

Code	Definition	Proportion of Answers
BASIC	Basic Elements of MBN Operation	46%
LOC	Effectiveness of MBN Based on Local Context	18%
POL	Political and Social Factors Affecting MBN Operation	9%
PART	Partnerships with Other Institutions to Improve MBN Operations	18%
UNI	Operations Strategies to Promote Universal Service	9%

Table 9 - Word Frequency Analysis of Reported Operations-Related Topics

Word	Count	Weighted Percentage
“‘human’”	1	1.85
“2500”	1	1.85
“access”	1	1.85
“addressed”	1	1.85
“affordable”	1	1.85
“best”	1	1.85
“budgetary”	1	1.85
“business”	1	1.85
“candidate”	1	1.85
“case”	1	1.85

Fig. 2 - Word Cloud of Reported Operations-Related Topics



In order to develop a more detailed context of the MBN knowledge landscape, I posed the question “How would you define ‘municipal broadband’” (Table 5). Data from this response can help answer the question ‘How do municipal managers learn about municipal broadband?’ by revealing the results of such learning methods. 64.1% of respondents offered a definition. The answers display a high level of uniformity. A majority of responses emphasize either the municipal ownership structure of an MBN, or the analogy between an MBN and a traditional water or energy utility. The former emphasis was especially popular, comprising a 44% plurality of total responses (Table 5). This indicates a significant level of background knowledge regarding MBNs, even among managers who have not implemented one themselves. However, bias could affect the responses, as managers who lack enough MBN knowledge to compose a concise definition may simply leave that particular question blank as they work through the survey.

Table 10 - Qualitative Analysis of Responses to "How would you define 'municipal broadband'? (n=25)

Code	Definition	Proportion of Answers
MUNI	Emphasis on Municipal Ownership/Operation	44%
NO	No Definition	12%
OTR	Other/Locally Specific	12%
SPD	Emphasis on High-Speed Capacity of Network	16%
UTIL	Emphasis on Analogy to Existing Utilities	16%

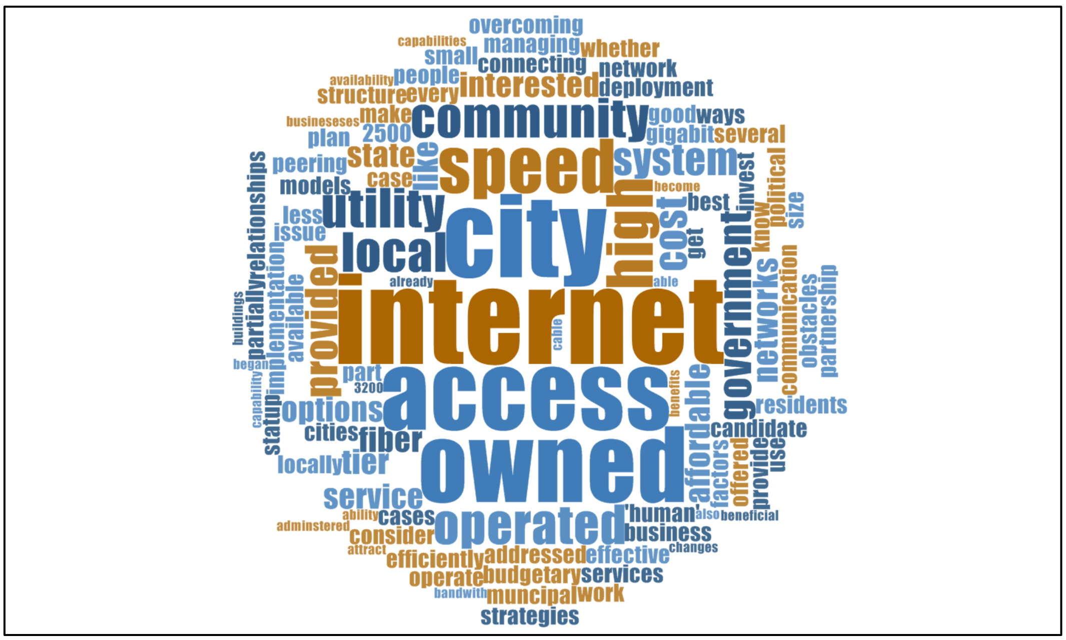
Table 11 - Coding of MBN Definition Responses

MUNI	a broadband system owned fully or partially by a city
MUNI	Local government owned internet service available to residents.
MUNI	Internet partially paid for by the city
MUNI	broadband offered through local government
MUNI	It sounds like internet service provided by the government.
MUNI	a public broadband utility adminstered by a City, County or Region
MUNI	broadband access owned/operated by a local government entity
MUNI	A municipally owned and operated system to provide high speed internet.
MUNI	City owned communications infrastructure.
MUNI	Muncipal owned, operated, and controlled internet access.
MUNI	Internet access provided in part or whole by a municipality
NO	none
NO	I am not sure
NO	I don't know what it means.
OTR	what neighborhoods are developed for MPN
OTR	For [community], it has been the ability to cover the major trafficways with fiber, connect over 50 buildings, and collaborate with [local institutions], and lease fiber two three communication companies.
OTR	Locally owned access to Tier 1 providers with right and capability to distribute access freely
SPD	High speed internet without bandwith limitation, provided as a municipal service.
SPD	High-speed int4ernet access.
SPD	publicly owned high speed internet
SPD	High speed internet and communication capabilities owned by a municipal corporation.
UTIL	A utility (like water) provided by the City to it's inhabitants
UTIL	operated as a muncipal utility
UTIL	Broadband services offered to residents as a utility.
UTIL	Internet access owned and operated by a City- like a city utility

Table 12 - Word Frequency Analysis of MBN Definition Responses

Word	Count	Weighted Percentage
“internet”	10	6.41
“owned”	10	6.41
“access”	7	4.49
“city”	7	4.49
“broadband”	5	3.21
“high”	5	3.21
“operated”	5	3.21
“speed”	5	3.21
“utility”	5	3.21
“government”	4	2.56

Fig. 3 - Word Cloud of MBN Definition Responses



4.2 - Retrospective Results

Some leaders have learned about municipal broadband firsthand by creating systems in their communities. The perspectives of these leaders provide an important benchmark. I expected them to define exactly how many months their system took to construct. However, both respondents claimed that they developed their systems incrementally over a period of several years (Table 13). Reports of cost were similarly indeterminate; one estimate ranged between “$4-5 million,” while another respondent reported “not to have a running total” (Table

14). These finding suggest that MBN planners should prepare for considerable levels of uncertainty. One manager, who had implemented an MBN for internal municipal government use, reported during an interview that the “actual installing of conduit and fiber in the ground is the major expense … about $13.00 per foot for conduit, fiber, hand-holes, splice enclosures, and labor.” I had hypothesized that broadband-specific technical needs, such as server farm maintenance, would present the greatest operations expense. However, the interviewed manager reported that “Personnel costs to manage the right-of-way inspections … and locate requests” presented the most significant O&M expense.

Table 13 - Q6 - How long did your municipality's network take to plan and build in total months?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		36	94.7	94.7	94.7
	Started 2003 - Continue to expand fiber network	1	2.6	2.6	97.4
	The City started installing fiber incrementally beginning in the late 1990's.	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

Table 14 - Q7 - How much did your municipality's network cost in total dollars?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		36	94.7	94.7	94.7
	$4 -5 million	1	2.6	2.6	97.4
	I do not have a running total. The CIty has done a lot of collaboration, trading, and cooperating with communication companies and working on grants and other sources of funding.	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

The motivating factors for municipal broadband implementation strongly support those highlighted in the literature. One respondent claimed that the factor which most strongly influenced their community's decision to implement such a network was “[municipal] Electric utility,” while another reported that it was “The inadequate options we had connecting 65 building at 45 locations” (Table 15). Both the literature and statistical analysis support the wide applicability of the former response (Walton 2014). Chi-Square testing shows that a significant positive correlation exists between the presence of an MBN and the presence of a municipal electric utility (Table 28). This result is a unique example of a case in which professional literature, qualitative findings, and quantitative findings all support my hypothesis that such a correlation exists.

Table 15 - Q8 - Which factor most strongly influenced your municipality's decision to implement a municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Other	2	5.3	100.0	100.0
Missing		36	94.7		
Total		38	100.0		

In addition to “Lack of Familiarity Among Citizens,” one of the greatest reported challenges to creating a community network was “Lack of financial and personnel resources” (Table 16). While the singular response to this data point limits its applicability, it is still noteworthy due to its close alignment with the most frequently reported perceived challenge factor among communities without an MBN. Even leaders who have not already implemented a network of their own can still have an accurate understanding of the challenges involved. For instance, a manager reported in an interview that “we have the same number of employees [in the IT departments] as we did in 2007," and that it would be difficult to establish an MBN for public use when resources were already so strained by the demands of supporting municipal use. This manager had performed "much of the work" on fiber development network on personal time outside of office hours.

Table 16 - Q9 - Which factor was the greatest challenge to creating your community's municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lack of Familiarity Among Citizens	1	2.6	50.0	50.0
	Other (Lack of financial and personnel resources.)	1	2.6	50.0	100.0
	Total	2	5.3	100.0	
Missing		36	94.7		
Total		38	100.0		

Although the barriers to creating an MBN can be daunting, the rewards can be significant. Both respondents from communities with MBNs agreed that the greatest benefit from their networks is "Improved Communication Among City Staff" (Table 17). This function could benefit residents by improving the response time for city service provision and reducing associated costs. The manager's responses differed regarding other benefits. "Reliability" and "Improving Adoption Rates Among Community Members," respectively, were the reported aspects of their systems that most exceeded performance expectations (Table 18). This indicates that MBNs help address both technocratic and social-justice-oriented concerns. However, both respondents reported that the aspect of their networks which most failed to meet expectations were "Effectiveness at Closing 'Digital Divides'" (Table 19).

Table 17 - Q10 - Which factor is the most important benefit from your community's municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Improved Communication Among City Staff	2	5.3	100.0	100.0
Missing		36	94.7		
Total		38	100.0		

Table 18 - Q11 - For which factor(s) would you most describe your municipality's network as performing 'Better than Expected'?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Success at Improving Adoption Rates Among Community Members	1	2.6	50.0	50.0
	Reliability	1	2.6	50.0	100.0
	Total	2	5.3	100.0	
Missing		36	94.7		
Total		38	100.0		

Table 19 - Q12 - For which factor(s) would you most describe your municipality's network as performing 'Worse than Expected'?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Effectiveness at Closing 'Digital Divides'	2	5.3	100.0	100.0
Missing		36	94.7		
Total		38	100.0		

This suggests that the benefits of MBN implementation may diffuse unevenly within communities. In the post-Fordist American landscape, economic development often diffuses in highly stratified patterns. For instance, one MBN aspect reported as most matching expectations was "Success at Promoting Economic Development" (Table 20). However, "Success at Closing Digital Divides" was not reported by any respondents. The only other aspect reported as most matching expectations was "Speed" (Table 20). This response is intended to measure data transfer speed, rather than the speed at which the system was constructed. This highly quantifiable factor often features prominently in marketing materials for broadband services, and likely plays a crucial role in perceptions of MBNs among both municipal leaders and the lay public.

Table 20 - Q13 - For which factor(s) would you most describe your municipality's network as 'Meeting Expectations'?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Speed	1	2.6	50.0	50.0
	Success at Promoting Economic Development	1	2.6	50.0	100.0
	Total	2	5.3	100.0	
Missing		36	94.7		
Total		38	100.0		

Mentorship from an experienced practitioner can be an effective learning strategy. For instance, KU's top-ranked Public Administration program provides students with the opportunity to work as interns at municipal governments in order to gain new skills, and KU's Geography program offers credit for students who complete internships and author reports regarding the knowledge that they have gained. Leaders in municipalities with MBNs provided recommendations for their counterparts in non-MBN communities through their responses. These responses emphasize the importance of sustained education and professional development, and reinforce the idea that local leadership is a critical factor in the development of socio-technical systems. One recommendation was "Collaborate with other anchor institutions, implement incrementally, join Next Century Cities, educate staff and management on options," while the other was "Education (sic) leaders on benefits of a fiber network" (Table 21). Even in high-technology sectors, the venerable techniques of collaboration and apprenticeship remain crucial to advancement. This reinforces the SCOT concept that micro-level social interactions are crucial to the successful implementation of macro-scale technological systems.

Table 21 - Q14 - What recommendations would you have for leaders who are considering implementing a broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		36	94.7	94.7	94.7
	Collaborate with other anchor institutions, implement incrementally, join Next Century Cities, educate staff and management on options.	1	2.6	2.6	97.4
	Education leaders on benefits of a fiber network	1	2.6	2.6	100.0
	Total	38	100.0	100.0	

4.3 - 'Push' and 'Pull' Factors

One of my key research questions is an identification of the incentives and disincentives experienced by leaders as part of the decision-making process regarding municipal broadband. Just as 'push' and 'pull' factors impact citizens' decisions to migrate across space, similar networks of influences shape leaders' decisions to migrate from private to public broadband utility systems. These include endogenous, exogenous, qualitative, and quantitative factors. Many of the results were surprising, but others match patterns previously highlighted by literature, media outlets, and case studies. Due to the complexity of MBN implementation and operation, I initially hypothesized that a variety of themes, including those based in social and political conditions, would guide MBN decision-making. However, such decision-making appears to be based strongly in financial and entrepreneurial factors.

I had anticipated that an association existed between themes selected for perceived incentives and disincentives, for instance, that leaders who selected "Cost" as the most significant disincentive would in turn select "Potential for Economic Development" as the most significant incentive. However, no such statistically significant association occurred (Table 35). This would seem to indicate that such MBN perceptions arise from prior knowledge of municipal networks, rather than observations of community conditions.

4.3.1 - Perceived Incentives

Many popular media outlets have covered municipal broadband favorably (Koebler 2016). Therefore, I expected many municipal leaders interested in MBNs to gain motivation from the opportunity to put their communities in the national spotlight. However, the benefit from municipal broadband anticipated by the greatest proportion of respondents was "Accelerated Economic Development" rather than "Improved Community Publicity/'Buzz'" (Table 22). This indicates a crucial role for pragmatic and quantifiable benefits, rather than improved public relations alone.

Table 22 - Q5 - Which factor do you anticipate would be the greatest benefit of a municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accelerated Economic Development	10	26.3	29.4	29.4
	Greater Broadband Adoption	4	10.5	11.8	41.2
	Improved Broadband Speed	5	13.2	14.7	55.9
	Improved Communication Among City Staff	3	7.9	8.8	64.7
	Improved Community Publicity/"Buzz"	3	7.9	8.8	73.5
	Reduced Broadband Cost	8	21.1	23.5	97.1
	Other (Don't Know)	1	2.6	2.9	100.0
	Total	34	89.5	100.0	
Missing		4	10.5		
Total		38	100.0		

Level of community demand was not associated with perceived incentives (Table 36). This suggests that mangers are receptive to community demand when choosing whether to implement an MBN, but also that their professional knowledge is a more significant factor in perceptions of MBNs than the perspective of citizens. Together, these patterns suggest that knowledge gained from professional development sources overall plays a key role in shaping MBN perceptions. Better and more complete data could help foster a higher quality and more holistic decision-making process.

Alternatively, a significant variance occurs between perceptions of MBN benefits when the analysis incorporates the community revenue indicators of housing value and median income (Table 37). Therefore, existing community conditions may indeed influence MBN perceptions, as leaders seek to identify remedies for economic development challenges or perceived stigmatization. Managers who focus on raising incomes within their community may foreground the economic development benefits of MBNs, while managers in more affluent communities may be interested in other priorities. For instance, the average median household income among respondents who reported that the greatest benefit of an MBN would be "Improved Communication Among City Staff" is over $10,000 higher than that among respondents who reported that the greatest MBN benefit would be "Improved Community Publicity/'Buzz'" (Table 38).

Furthermore, the only data element with significant variance between the categories of MBN planning was the poverty rate (Table 29). Statistical analysis shows a positive correlation between likelihood to implement an MBN within the next five years and the poverty rate (Table 30). This result likely stems from the prominent role of economic development benefits in perceptions of MBN benefits. For instance, Next Century Cities, a municipal-government-backed advocacy group that publishes educational materials regarding telecommunications for public officials, lists "new opportunities for small businesses, to higher property values, to a stronger local economy" as three of the four key benefits of improved broadband infrastructure in its Policy Agenda (NCC 2015, 2). Internet connectivity is not a panacea for poverty. However, communities with more severe and immediate poverty challenges may be more motivated to attempt alternative economic development solutions, such as MBNs, than communities who are relatively secure in their affluence.

This link between poverty and implementation likelihood may seem counterintuitive, as communities with reduced levels of financial capital may have fewer resources to invest in broadband infrastructure. However, such communities, if sufficiently motivated and organized, can obtain capital from federal grant programs. Research suggests that social capital and collective problem-solving ability, known as entrepreneurial social infrastructure, plays a greater role than financial capital alone in fostering rural economic development (Flora et al. 1997). For instance, the level of federal financial capital available for innovation and development in the rural U.S. south is not limited by poverty levels in a given locality (Hall and Howell-Moroney 2012).

One complicating data point is the lack of significant variation in community revenue proxies between respondents who reported each perceived disincentive as most significant. I had hypothesized that communities with lower property values would view financial factors as more significant MBN obstacles than their more affluent counterparts. However, no such difference exists (Table 40).

One important MBN benefit identified in literature is "Improved Communication Among City Staff" (Kelley 2004). I expected this to be an important motivating factor, as many communities with broadband networks accessible to citizens initially created their networks to facilitate communication among municipal employees. However, "Improved Communication Among City Staff" was only cited by 8.8% of respondents (Table 22). This suggests that leaders primarily consider the needs of citizens, rather than municipal staff, when making planning decisions. It could also indicate that communications-intensive innovations such as 'smart' electrical grids and automated meter reading systems diffuse relatively slowly and unevenly. This result raises a noteworthy disjuncture, as communities with MBNs unanimously reported that "Improved Communications Among City Staff" was in fact the greatest benefit of their systems. This paradox indicates an opportunity for educating municipal mangers regarding the benefits for interdepartmental communication offered by MBNs.

Another opportunity for education lies in the area of community demand. A plurality of respondents indicated that the level of demand for an MBN among citizens in their community was “None” (Table 24). Furthermore, an outright majority reported that the level of demand was either “A Little” or “None” (Table 24). Outreach efforts to citizens and community organizers could increase levels of grassroots demand for MBNs. However, the bimodality of results for the questions regarding community demand does indicate optimism for MBN prospects. More than one in ten respondents reported that “a great deal” of demand exists for an MBN (Table 24). Tacit knowledge from members of communities that already have implemented MBNs could motivate favorable perceptions in their non-MBN counterparts. Additionally, citizens who support MBNs could have gained knowledge from popular media outlets, which have highlighted the successful systems in places such as Chattanooga.

Table 23 - Q17 - How much demand currently exists among members of your community for a municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A great deal	4	10.5	11.8	11.8
	A lot	1	2.6	2.9	14.7
	A moderate amount	8	21.1	23.5	38.2
	A little	7	18.4	20.6	58.8
	None	14	36.8	41.2	100.0
	Total	34	89.5	100.0	
Missing		4	10.5		
Total		38	100.0		

Statistical comparison between the level of reported community demand from a municipal broadband network and reported implementation plans show that the likelihood of planned implementation increases in lockstep with perceived demand (Table 31). A statistically significant positive association also exists between population size and likelihood of planned implementation (Table 29). This indicates that municipal leaders are responsive to the desires of their constituents. It also indicates that large communities, rather than rural ones, may be more likely to implement MBNs. Such communities, which benefit from economies of scale, likely have greater reserves of both human capital and financial capital for investment in an MBN project. A statistically significant positive association exists between population size and stated level of demand among citizens (Table 42). The mean population of communities that reported "A Great Deal" of demand is over 100,000, while the mean population of communities that reported "A Little" demand is less than 15,000. Literature supports this finding, as the prominent case study of Chattanooga represents a metropolitan area (Lobo et al. 2008). Education initiatives could help citizens of rural communities learn more about the benefits of MBNs for regions outside of major metropolitan areas.

4.3.2 - Perceived Disincentives

Due to the often-slow pace of technological innovation and diffusion among municipal utility institutions, I expected that "Lack of Familiarity Among Staff" would be a major disincentive. In fact, "Cost of Equipment/Right-of-Way" was the most frequently cited disincentive (Table 23). This result is not surprising, given that secondary data shows disproportionately low levels of economic development among responding communities. Historic disinvestment in infrastructure and the resulting multitude of competing priorities exacerbate funding shortages. For instance, a leader reported that

> "We perused funding opportunities through both the issuance of bonds and USDA Rural development grants as we explored the option of a municipal broadband company. Given the overall aging infrastructure faced here as well as all small rural communities, we

determined that access to these grant opportunities would be better utilized to address water quality, roadways, and waste water improvements."

Table 24 - Q16 - Which factor do you anticipate would present the greatest challenge to implementing a municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cost of Equipment/Right-of-Way	21	55.3	61.8	61.8
	Lack of Familiarity Among Staff	2	5.3	5.9	67.6
	State Restrictions	5	13.2	14.7	82.4
	Other	6	15.8	17.6	100.0
	Total	34	89.5	100.0	
Missing		4	10.5		
Total		38	100.0		

"Which factor do you anticipate would present the greatest challenge to implementing a municipal broadband network?" - Other
Politics
The fact that we already have Fiber Optic here, and it operates rather seamlessly via [ISP].
Cost of implementation, other than equipment/right-of-way
Municipal competition with private business
Unwillingness of the governing body to duplicate/complete with private enterprise.

Additionally, statistical analysis shows a significant inverse correlation between the perception of cost as the most significant barrier to MBN implementation and the likelihood of stated plans to create one (Table 33). No correlation exists between perceived benefits and implementation plans (Table 32). Level of community demand was not associated with perceived disincentives (Table 39). This suggests that other projected benefits provide a counterweight to the primacy of economic development. Alternatively, many of the communities that perceive that economic development is the most significant perceived benefit may not have a high level of confidence in the ability of an MBN to deliver any benefits. They may choose to allocate scare funds to other priorities, which they believe have a greater likelihood of producing economic development benefits or improving overall quality of city services. The only secondary data point with a statistically significant association to perceived disincentives was proportion of the population comprised of persons of color. More diverse communities were less likely to cite 'Lack of Familiarity Among Staff' as a disincentive. Higher levels of diversity may indicate communities that are larger, and thus have more resources available to municipal personnel. For instance, population size alone nearly meets the threshold of statistical significance for association with chosen perceived disincentive.

A minority of managers chose "State Restrictions" as the most significant perceived barrier (Table 23). Statistical analysis supports the concept that state restrictions are a relatively weak disincentive. A positive association exists between perceptions of them as the most significant perceived barrier and likelihood of planned near-term MBN implementation (Table 33). The decisive defeat of a municipal broadband restriction bill in the Kansas State Senate in 2014 could explain this trend. Managers may believe that a similar bill is unlikely for proposal in the near term. This pattern also supports the concept that cost is the most significant barrier to MBN implementation.

My conclusion regarding this result follows the operational research themes originally developed by British military statistician Abraham Wald. He realized that patterns of concentrated damage on aircraft returning from battle showed not locations in need of additional armor, as was originally theorized, but locations where armor was unnecessary. The optimal location for additional armor was in fact areas where no damage was present, as aircraft with damage in these areas did not survive to return for observation (Mangel and Samaniego 1984). Similarly, communities with surviving MBN implementation plans tend to cite state restrictions as the greatest obstacle, while communities with no such plans tend to cite cost as the greatest obstacle. The conclusion results that cost is the more significant obstacle, as it is associated with a lack of MBN implementation plans.

Ultimately, over three-quarters of responding communities reported that they have no plans to implement an MBN (Table 25). Only five percent of responding communities reported that they plan to implement one within the relatively immediate time scale of five years (Table 25). No responding communities reported planned MBN implementation within the scale of one year (Table 25). This pattern indicates that the disincentives to MBN implementation currently outweigh the incentives in the minds of most municipal leaders. It underscores the multifaceted definitions of the 'digital divide' concept. A 'digital divide' occurs between the successful results of MBN projects, and the perception of MBNs among Kansas municipal leaders. From Chanute to Chattanooga, MBNs have made tangible progress at energizing community development. However, few Kansas managers appear to be sufficiently aware of or motivated by the results of these case studies to implement MBNs in their own communities. Additionally, a similar divide occurs between the level of financial resources necessary to create an MBN and the financial resources available to most rural municipal governments.

Table 25 - Q18 - Which best describes your community's plans for creating a municipal broadband network?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Plans to Implement	27	71.1	79.4	79.4
	Considering Implementation Indefinitely	5	13.2	14.7	94.1
	Likely to Implement Within the Next Five Years	2	5.3	5.9	100.0
	Total	34	89.5	100.0	
Missing		4	10.5		
Total		38	100.0		

4.4 - Leading Indicators of Broadband Leadership

Due to the limited sample size of communities with MBNs, I conducted analyses to investigate unique trends among communities that have already implemented operational MBNs, as well as among communities that reported plans to implement an MBN within the next five years. I hypothesized that median housing value would be correlated with the presence of MBNs, as municipalities with higher levels of property tax revenue would have more resources to offset the cost. ANOVA does not support this hypothesis; no significant variance in median housing value exists between communities with an MBN and those without (Table 26). Surprisingly, no significant variation in median household income exists between communities with and without MBNs (Table 26). The small sample size of the former could influence this result. However, it suggests a promising pattern in which low levels of income and revenue do not preclude MBN implementation. Additionally, no significant variation exists in educational attainment rates between communities that reported high levels of demand for MBNs and those who reported low levels (Table 26). This suggests that interest in MBNs is not limited to those with higher education, and that even community members with relatively low levels of education perceive benefits of MBNs.

Broadband innovation may be an equitable path to greater prosperity for core and disadvantaged communities alike. It can even help turn the latter into the former. The only statistically significant variation observed between communities with MBNs and those without was population growth rate (Table 26). Growth rate is positively associated with MBN presence (Table 27). While statistical analyses do not explicitly define the direction of causality, findings from case studies described in the literature suggest that MBNs can help communities recruit and retain satisfied citizens (Ford and Koutsky 2005). Alternatively, communities with higher growth rates may be more likely to have major infrastructure construction projects, such as the extension of utility service to growth boundaries.

Implementing an MBN simultaneously with other capital projects can help lower the barrier to entry. Literature identifies the presence of a municipal electric utility as another key factor that lowers the barrier to entry for broadband innovation (Bar and Park 2006). A statistically significant correlation exists between the presence of a municipal electric utility and an MBN, confirming this pattern (Table 28).

4.5 - Interview Results

Only one municipal manager provided further detail through a telephone interview. This qualitative data was helpful in adding context to survey results. It confirmed some survey and literature conclusions, but challenged others. While I had hypothesized that MBN creation was a primarily endogenous process, many of the operations-related topics reported as priorities for future learning involved partnerships with actors outside of City Hall. The manager underscored this result during the interview by explaining that his/her community had evaluated MBN feasibility through work with an outside consulting firm. The manager chose a firm after viewing multiple proposals. The manager described the firm as “really having a niche on [community broadband planning].” However, the firm’s expertise came at a high monetary cost, which may make outside assistance difficult for smaller communities. The firm “recommended caution” on establishing a fiber-to-the-home (FTTH) MBN, and advised that the city should leverage existing partnerships with community anchor institutions and private firms.

Another exogenous factor involved in municipal broadband planning is the proximity to existing backbone infrastructure. The manager indicated that “the biggest thing that [communities] have to have” for a successful MBN is a connection to a colocation center, such as the facility located at 1102 Grand Boulevard in Kansas City, MO. For instance, Chanute, KS is located along the path of a major interstate fiber trunk line, reducing the cost of high-capacity connectivity. This result reflects the spatiality of cyberinfrastructure emphasized by the literature (Zook 2008). Just as Harvey Houses flourished along the major transcontinental railroad lines of the 19th century, and hospitality industries develop along today’s Interstate Highway System, broadband infrastructure may be most concentrated along the linear pathways of fiber ‘superhighways.’ However, few survey respondents reported distance to a fiber trunk line as the primary challenge for MBN implementation, raising questions regarding the broader spatial applicability of this data point.

The interview highlighted the multidimensional nature of MBN planning. The White House Report does not describe the city in question as possessing an MBN, since the city’s network is, at present, only available for municipal use and leasing by private broadband firms. During the interview, the manager concurred with the consultant’s findings of significant obstacles to expanding the network for public access. The city does not operate a municipal electric utility, and therefore lacks existing economies of scale such as "poles to install the fiber on, and … personnel and bucket trucks required to support such a network." The manager did note that the city's broadband Intranet had been successful at improving communications among water system treatment, distribution, and administration personnel. This provided the additional benefit of helping facilitate compliance with water treatment regulations that became stricter during the system's construction period.

In addition to technological infrastructure, leaders describe economic and social factors as MBN disincentives. Competition from existing carriers would decrease the "take rate," or proportion of potential customers who subscribe to broadband service, of a hypothetical MBN. Google and other firms with multiple products can subsidize fiber development losses with advertising revenue, but a municipality would be dependent upon "a mill-levy [tax] increase, or the issuing of bonds" for funding. Such funding sources would face significant opposition from citizens skeptical of property or sales tax rate increases. One of the most common themes expressed by the manager in relation to MBNs was "everything's political." This comment supports the idea that the nature of interactions between community members and leaders, rather than simply factors of technical capacity, guide MBN implementation.

5 – Conclusions and Recommendations

Research provides opportunities for advancing alternative societal structures that represent practical steps toward promoting economic equality (Howitt and Stevens 2010). In addition to summarizing the overall themes of my results, I attempt to harness this opportunity by framing my conclusions in the context of applicable policy recommendations. My main research question is 'What incentives and disincentives impact municipal leaders as they make decisions regarding municipal broadband?' My results provide insights into processes by which incentives could be capitalized upon and disincentives could be overcome, thus promoting MBN implementation at the individual, community, and state/national scales. Initiatives that bridge these levels of leadership could create a cohesive force for guiding the socio-technical system of broadband Internet infrastructure in a new and more sustainable direction. These results are useful for the advancing the state of Social Construction of Technology (SCOT) research since they highlight the perceptions and perspectives of human agents embedded within the institutional context of municipal governance and the socio-politico context of rural Kansas.

My results provide insights regarding the existing landscape of MBN development, as well as future trends in which forward-thinking leaders could alter this landscape. MBNs, perceived as systems owned by a municipality that provide broadband access in a manner analogous to a public utility, are relatively uncommon in Kansas. They are most common in rapidly growing communities, as well as those that already operate a municipal electric utility. However, many municipal leaders already possess knowledge regarding MBNs gained through professional conferences and job training. They are most interested in learning about tactics for effective operations, especially within a holistic local context.

MBNs are costly to construct in terms of both time and money. Cost is the most significant perceived disincentive for MBN implementation. Municipal leaders are most likely to report near-term implementation plans in large communities and in those with a high poverty rate. Community demand is associated with planned implementation likelihood, but such demand is relatively low in Kansas. This low level of demand may be associated with the agriculture-based economy in much of the state. Compared to workers in sectors such as ICT, media, and education, agricultural workers interact with 'Code/Space' less regularly, limiting perceptions of broadband's necessity. Economic development is the most significant perceived incentive for MBN implementation. This matches conclusions from writers such as Graham and Marvin, who note that "the development of advanced systems … has been targeted by localities attempting to capture firm investment" (Graham and Marvin 1996). Communities with MBNs report that the most important benefit of their systems is improved communications among city staff, but that MBNs underperform expectation with respect to closing the 'digital divide.' These results suggest that managerial entrepreneurialism informs municipal leaders' responses to perceptions of MBN implementation 'push' and 'pull' factors (Harvey 1989).

5.1 - Citizen Advocacy

Survey data shows that 'community demand' is an important answer to the research question 'What incentives impact leaders as they make decisions regarding municipal broadband'? Literature shows that municipal broadband can improve economic productivity and equality in communities. The positive association between community demand and implementation plans suggests that grassroots initiatives by citizen-activists could be an effective strategy for promoting MBNs. However, the significance of economic development as an anticipated MBN benefit suggests that such activists should couch their demands in the rhetoric of entrepreneurial expansion.

Another perceived barrier to MBN implementation is small population size. Outreach efforts from government, nonprofit, and industry stakeholders should consider specifically targeting communities of fewer than 2,500 people to ensure that leaders in such communities recognize their potential for implementing innovation.

A promising public outreach effort would be speed-test applications. Facilitating Internet speed testing among community members could help users better understand the limitations of existing connections and gain a greater sense of digital agency. It could help bolster demand for MBNs in the peripheral rural communities most struggling with poverty and population loss. Internet speed could serve as a means for fostering pride of place among community members. For instance, visitors who enter Chattanooga from Interstate 24 encounter a billboard announcing "Welcome to Gig City – Home of America's Fastest Internet"

5.2 – Policy Recommendations for Tacit Knowledge Development at the Municipal and Regional Levels

The professional development tactics of municipal leaders highlight the importance of tacit knowledge in building human capital. Survey data shows that 'professional conferences' are an important answer to the research question 'How do municipal leaders learn about municipal broadband to gain information for making decisions?' Agglomeration economies like those found in Silicon Valley and Silicon Alley underscore the importance of 'weak ties' and informal social interaction to fostering innovation in high-technology fields (Fang, Fan and Wang 2010). However, this model of clustering requires a high level of population density, which is not present in rural areas that are especially in need of municipal broadband due to their diseconomies of scale for private, profit-driven systems.

Perhaps a ‘Green Drinks’ model could be applied across rural regions, such as the Flint Hills of Kansas, which already have a distinct sense of place. ‘Green Drinks’ is a series of networking events organized in cities around the world. Attendees are typically engaged in sustainability-related professions or degree programs, and are interested in learning about innovations from a diverse group of colleagues and partners in activism (Horwitch and Mulloth 2010). Municipal managers could meet formally or informally to facilitate knowledge sharing. The events could be labeled ‘Meet-Me Rooms,’ as ‘meet-me room’ is a colloquial term for a location within a data center where internet service providers and content delivery networks link their respective systems to reduce latency. The Kansas Water Office has applied a similar model by creating Regional Planning Areas (RPAs), and hosting meetings for water resource stakeholders. Additionally, the Water Office hosts an annual professional development conference, at which knowledge can flow from state-scale leaders to those who work at the regional and municipal scales. Just as the physical infrastructure of broadband utilities mimics that of its water and energy counterparts, successful professional development and education ‘infrastructure’ for the broadband utility sector could take a page from the book of existing professional development strategies for water and energy personnel.

5.3 - State and Federal Resources

Survey data shows that 'cost' is an important answer to the research question 'What are the most significant perceived and actual challenges to implementing MBNs?' Federal funding could be an important tool for fostering broadband innovation. The level of initial investment required to establish such a system is a significant perceived barrier to implementation. Faced with many competing priorities such as water systems, law enforcement, and recreational facilities, many communities struggle to find the necessary capital for MBN genesis, operations, and maintenance. Greater federal and state investment in municipal broadband could provide capital for connectivity. However, responding communities that have implemented MBNs have lower median household incomes and higher poverty rates than their non-MBN counterparts, suggesting both that leaders view MBNs as a key strategy for raising incomes, and that digital innovation can take root even in disadvantaged settings. Grant funding from non-municipal sources can help create fertile ground in which MBNs can thrive. White House-led infrastructure investment plans should incorporate digital utilities – bridges to the 'Information Superhighway' – in addition to traditional heavy civil engineering projects. For instance, 'dig once' policies incentivize contractors to install fiber conduit in the right-of-way of federal transportation projects (Fung 2015a). Such conduit can accommodate multiple strands of fiber from several providers, reducing the capital cost of fiber deployment and facilitating increased levels of competition among ISPs. Fiber optic networks may not have the blue-collar connotation of concrete and steel, but they can provide 'concrete' quantifiable benefits to rural communities.

5.4 - Future Developments

One of the key conclusions from my findings is the relative rarity of municipal broadband. The chief obstacle to gathering data regarding MBN implementation is the sheer lack of existing MBNs. However, as more communities implement such networks, more tacit knowledge will become available. Each manager who implements an MBN will be able to share lessons learned from his/her experiences with other mangers, further reducing barriers to entry. Another cycle that could help promote MBN implementation is cost efficiency. MBNs are successful at improving communication among municipal personnel; this could lead to cost savings from improved productivity, which in turn could free up additional funding for MBN expansion and capacity building. These positive feedback loops bode well for the future of municipal broadband, even as political changes will likely lead to reduced interest in net neutrality and universal service considerations within the Federal Communications Commission.

The FCC's role highlights important issues of geographic and administrative scale involved in municipal broadband. Federal government institutions overall have suffered declines in public trust during recent years of political hyper-polarization. Steve Goldsmith, a professor at Harvard's Kennedy School of Government, notes that "72 percent of Americans said that they trusted their local governments a "great deal" or a "fair amount," even though the trust level for government in general fell to a meager 24 percent" (Goldsmith 2015). By transferring information across vast distances at the speed of light, broadband networks catalyze spatiotemporal compression to an unprecedented degree. However, despite their extraordinary international spatial scale, such networks grow upon efforts and investments made at the local level. As SCOT theory emphasizes, even the most advanced information systems cannot diffuse equitably through diverse societies without active guidance from social and political networks.

The Next Century Cities Policy Agenda explains that "Some of the best places in the United States to get Internet access are [those] where local governments directly provide the service" (NCC 2015, 6). In the years to come, municipal governments that pursue broadband innovation are likely to take center stage as Americans' gateway to the global space of information flows.

Tables

MBN Development Indicators

Indicators of Presence

Table 26

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pop_2015	Between Groups	2221134753.309	1	2221134753.309	.506	.482
	Within Groups	149351846965.441	34	4392701381.337		
	Total	151572981718.750	35			
Pop_2010	Between Groups	1862407266.864	1	1862407266.864	.442	.511
	Within Groups	143241873713.441	34	4212996285.689		
	Total	145104280980.306	35			
Growth_Rate	Between Groups	36.544	1	36.544	1.963	.170
	Within Groups	632.819	34	18.612		
	Total	669.363	35			
Med_Income_14	Between Groups	5318514.222	1	5318514.222	.033	.857
	Within Groups	5485047113.000	34	161324915.088		
	Total	5490365627.222	35			
Poverty_Rate_14	Between Groups	40.071	1	40.071	.549	.464
	Within Groups	2479.489	34	72.926		
	Total	2519.560	35			
House_Value_14	Between Groups	1662779326.771	1	1662779326.771	.903	.349
	Within Groups	62574583302.118	34	1840428920.651		
	Total	64237362628.889	35			
HS_Grad_Rate_14	Between Groups	21.722	1	21.722	.723	.401
	Within Groups	1021.027	34	30.030		
	Total	1042.750	35			
PoC_14	Between Groups	80.602	1	80.602	.942	.339
	Within Groups	2909.354	34	85.569		
	Total	2989.956	35			

Table 27

	Q3 - Does your municipality own and operate a municipal broadband network?	
	Yes	No
	Mean	Mean
Pop_2015	51584.50	17293.18
Pop_2010	48381.00	16980.68
Growth_Rate	4.31	-.09
Med_Income_14	44202.50	45880.50
Poverty_Rate_14	20.05	15.44
House_Value_14	121850.00	92180.24
HS_Grad_Rate_14	92.70	89.31
PoC_14	17.30	10.77

Table 28

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Muni_Electric * Q3 - Does your municipality own and operate a municipal broadband network?	36	94.7%	2	5.3%	38	100.0%

Muni_Electric * Q3 - Does your municipality own and operate a municipal broadband network? Crosstabulation

Count

		Q3 - Does your municipality own and operate a municipal broadband network?		Total
		Yes	No	
Muni_Electric	N	1	32	33
	Y	1	2	3
Total		2	34	36

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.813[a]	1	.028		
Continuity Correction[b]	.770	1	.380		
Likelihood Ratio	2.667	1	.102		
Fisher's Exact Test				.162	.162
N of Valid Cases	36				

a. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .17.

b. Computed only for a 2x2 table

Indicators of Plans

Table 29

ANOVA - Factor is Stated Implementation Plans (Q18)

		Sum of Squares	Df	Mean Square	F	Sig.
Pop_2015	Between Groups	909132981.478	2	454566490.739	.097	.908
	Within Groups	144858632871.463	31	4672859124.886		
	Total	145767765852.941	33			
Pop_2010	Between Groups	885835742.641	2	442917871.321	.099	.906
	Within Groups	139273028682.800	31	4492678344.606		
	Total	140158864425.441	33			
Growth_Rate	Between Groups	11.892	2	5.946	.305	.739
	Within Groups	604.681	31	19.506		
	Total	616.574	33			
Med_Income_14	Between Groups	288171441.626	2	144085720.813	.862	.432
	Within Groups	5182008066.874	31	167161550.544		
	Total	5470179508.500	33			
Poverty_Rate_14	Between Groups	314.188	2	157.094	2.252	.122
	Within Groups	2162.176	31	69.748		
	Total	2476.364	33			
House_Value_14	Between Groups	4344414347.155	2	2172207173.577	1.296	.288
	Within Groups	51946963954.963	31	1675708514.676		
	Total	56291378302.118	33			
HS_Grad_Rate_14	Between Groups	26.443	2	13.221	.416	.663
	Within Groups	984.904	31	31.771		
	Total	1011.347	33			
PoC_14	Between Groups	16.750	2	8.375	.091	.913
	Within Groups	2840.584	31	91.632		
	Total	2857.334	33			

Table 30

	Q18 - Which best describes your community's plans for creating a municipal broadband network?			
	No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Year	Likely to Implement Within the Next Five Years
	Mean	Mean	Mean	Mean
Pop_2015	19868.04	5856.00	.	11125.50
Pop_2010	19517.00	5644.80	.	11080.00
Growth_Rate	-.17	1.01	.	-1.77
Med_Income_14	45952.19	49657.20	.	35471.00
Poverty_Rate_14	14.91	13.54	.	27.45
House_Value_14	88226.96	118880.00	.	78800.00
HS_Grad_Rate_14	89.45	89.94	.	85.85
PoC_14	11.07	9.08	.	10.90

Table 31

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q17 - How much demand currently exists among members of your community for [an MBN]? * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q17 - How much demand currently exists among members of your community for [an MBN}? * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstabulation

		Q18 - Which best describes your community's plans for creating [an MBN]?			Total
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	
Q17 - How much demand currently exists among members of your community for [an MBN]?	A great deal	2	1	1	4
	A lot	0	0	1	1
	A moderate amount	6	2	0	8
	A little	6	1	0	7
	None	13	1	0	14
Total		27	5	2	34

a. 12 cells (80.0%) have expected count less than 5. The minimum expected count is .06.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.410[a]	8	.004
Likelihood Ratio	12.689	8	.123
Linear-by-Linear Association	7.605	1	.006
N of Valid Cases	34		

Table 32

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?* Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]? * Q18 - Which best describes your community's plans for creating [an MBN]?
Crosstabulation

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?	Accelerated Economic Development	6	2	2	10
	Greater Broadband Adoption	2	2	0	4
	Improved Broadband Speed	5	0	0	5
	Improved Communication Among City Staff	3	0	0	3
	Improved Community Publicity/"Buzz"	3	0	0	3
	Reduced Broadband Cost	7	1	0	8
	Other	1	0	0	1
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.787[a]	12	.463
Likelihood Ratio	12.371	12	.416
Linear-by-Linear Association	4.946	1	.026
N of Valid Cases	34		

a. 19 cells (90.5%) have expected count less than 5. The minimum expected count is .06.

Table 33

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]?* Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]? * Q18 - Which best describes your community's plans for creating [an MBN]? Crosstabulation

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]?	Cost of Equipment/Right-of-Way	16	5	0	21
	Lack of Familiarity Among Staff	2	0	0	2
	State Restrictions	3	0	2	5
	Other	6	0	0	6
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	15.387[a]	6	.017
Likelihood Ratio	13.168	6	.040
Linear-by-Linear Association	.300	1	.584
N of Valid Cases	34		

a. 11 cells (91.7%) have expected count less than 5. The minimum expected count is .12.

Table 34

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q1 - Where have you learned about [MBNs]? Job Training * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%
Q1 - Where have you learned about [MBNs}? Popular Media * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%
Q1 - Where have you learned about [MBNs]? Professional Conferences * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%
Q1 - Where have you learned about [MBNs]? Professional Media * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%
Q1 - Where have you learned about [MBNs]? This Survey * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%
Q1 - Where have you learned about [MBNs}? Other * Q18 - Which best describes your community's plans for creating [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q1 - Where have you learned about [MBNs]? Job Training * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstab

Count

		Q18 - Which best describes your community's plans for creating an [MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q1 - Where have you learned about [MBNs]? Job Training	0	20	3	1	24
	1	7	2	1	10
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.836[a]	2	.658
Likelihood Ratio	.788	2	.674
Linear-by-Linear Association	.749	1	.387
N of Valid Cases	34		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .59.

Q1 - Where have you learned about [MBNs]? Popular Media * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstab

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q1 - Where have you learned about [MBNs]? Popular Media	0	23	4	1	28
	1	4	1	1	6
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.609[a]	2	.447
Likelihood Ratio	1.259	2	.533
Linear-by-Linear Association	1.456	1	.228
N of Valid Cases	34		

a. 5 cells (83.3%) have expected count less than 5. The minimum expected count is .35.

Q1 - Where have you learned about [MBNs]? Professional Conferences * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstab

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q1 - Where have you learned about [MBNs]? Professional Conferences	0	17	2	0	19
	1	10	3	2	15
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.594[a]	2	.166
Likelihood Ratio	4.338	2	.114
Linear-by-Linear Association	3.483	1	.062
N of Valid Cases	34		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .88.

Q1 - Where have you learned about [MBNs]? Professional Media * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstab

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q1 - Where have you learned about [MBNs]? Professional Media	0	21	4	1	26
	1	6	1	1	8
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.839[a]	2	.657
Likelihood Ratio	.720	2	.698
Linear-by-Linear Association	.553	1	.457
N of Valid Cases	34		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .47.

Q1 - Where have you learned about [MBN]? This Survey * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstab

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q1 - Where have you learned about [MBNs]? This Survey	0	19	5	2	26
	1	8	0	0	8
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.712[a]	2	.258
Likelihood Ratio	4.285	2	.117
Linear-by-Linear Association	1.859	1	.173
N of Valid Cases	34		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .47.

Q1 - Where have you learned about [MBNs]? Other * Q18 - Which best describes your community's plans for creating [an MBN]?

Crosstab

Count

		Q18 - Which best describes your community's plans for creating [an MBN]?			
		No Plans to Implement	Considering Implementation Indefinitely	Likely to Implement Within the Next Five Years	Total
Q1 - Where have you learned about [MBNs]? Other	0	23	5	2	30
	1	4	0	0	4
Total		27	5	2	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.175[a]	2	.556
Likelihood Ratio	1.978	2	.372
Linear-by-Linear Association	.805	1	.369
N of Valid Cases	34		

a. 5 cells (83.3%) have expected count less than 5. The minimum expected count is .24.

Indicators of Perceived Benefit

Table 35

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]? * Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]?. * Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]? Crosstabulation

Count

		Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?							Total
		Accelerated Economic Development	Greater Broadband Adoption	Improved Broadband Speed	Improved Communication Among City Staff	Improved Community Publicity/"Buzz"	Reduced Broadband Cost	Other	
Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]?	Cost of Equipment/Right-of-Way	5	3	4	2	3	4	0	21
	Lack of Familiarity Among Staff	0	0	0	1	0	1	0	2
	State Restrictions	3	0	0	0	0	2	0	5
	Other	2	1	1	0	0	1	1	6
Total		10	4	5	3	3	8	1	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.629[a]	18	.480
Likelihood Ratio	18.232	18	.441
Linear-by-Linear Association	.023	1	.879
N of Valid Cases	34		

a. 27 cells (96.4%) have expected count less than 5. The minimum expected count is .06.

Table 36

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q17 - How much demand currently exists among members of your community for [an MBN]? * Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q17 - How much demand currently exists among members of your community for [an MBN]? * Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]? Crosstabulation

Count

		Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?							Total
		Accelerated Economic Development	Greater Broadband Adoption	Improved Broadband Speed	Improved Communication Among City Staff	Improved Community Publicity/"Buzz"	Reduced Broadband Cost	Other	
Q17 - How much demand currently exists among members of your community for [an MBN]?	A great deal	3	0	1	0	0	0	0	4
	A lot	1	0	0	0	0	0	0	1
	A moderate amount	2	0	0	1	2	3	0	8
	A little	0	2	1	1	0	3	0	7
	None	4	2	3	1	1	2	1	14
Total		10	4	5	3	3	8	1	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	21.174[a]	24	.628
Likelihood Ratio	25.924	24	.357
Linear-by-Linear Association	1.244	1	.265
N of Valid Cases	34		

a. 35 cells (100.0%) have expected count less than 5. The minimum expected count is .03.

Table 37

ANOVA - Factor is Perceived Benefit

		Sum of Squares	df	Mean Square	F	Sig.
Pop_2015	Between Groups	27547658063.483	6	4591276343.914	1.049	.417
	Within Groups	118220107789.458	27	4378522510.721		
	Total	145767765852.941	33			
Pop_2010	Between Groups	26435759423.225	6	4405959903.871	1.046	.418
	Within Groups	113723105002.217	27	4211966851.934		
	Total	140158864425.441	33			
Growth_Rate	Between Groups	112.213	6	18.702	1.001	.445
	Within Groups	504.361	27	18.680		
	Total	616.574	33			
Med_Income_14	Between Groups	1356783689.333	6	226130614.889	1.484	.221
	Within Groups	4113395819.167	27	152347993.302		
	Total	5470179508.500	33			
Poverty_Rate_14	Between Groups	453.194	6	75.532	1.008	.441
	Within Groups	2023.170	27	74.932		
	Total	2476.364	33			
House_Value_14	Between Groups	17914931879.451	6	2985821979.908	2.101	.086
	Within Groups	38376446422.667	27	1421349867.506		
	Total	56291378302.118	33			
HS_Grad_Rate_14	Between Groups	315.923	6	52.654	2.044	.094
	Within Groups	695.424	27	25.756		
	Total	1011.347	33			
PoC_14	Between Groups	408.937	6	68.156	.752	.614
	Within Groups	2448.397	27	90.681		
	Total	2857.334	33			

Table 38

	Q5 - Which factor do you anticipate would be the greatest benefit of [an MBN]?							
	Accelerated Economic Development	Greater Broadband Adoption	Improved Broadband Access for Schools and Colleges	Improved Broadband Speed	Improved Communication Among City Staff	Improved Community Publicity/"Buzz"	Reduced Broadband Cost	Other
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Pop_2015	5197.50	6582.25	.	85301.00	15697.67	387.67	4344.88	144.00
Pop_2010	5161.20	6332.75	.	83573.60	15767.00	397.33	4237.00	143.00
Growth_Rate	.55	1.93	.	-.42	3.42	-2.01	-2.40	.70
Med_Income_14	49086.00	55060.50	.	48314.00	51329.33	39309.00	37231.25	37500.00
Poverty_Rate_14	14.63	13.13	.	11.32	10.23	21.63	19.65	16.90
House_Value_14	107850.00	110625.00	.	95720.00	120233.33	44776.00	74625.00	42500.00
HS_Grad_Rate_14	90.57	92.30	.	91.38	91.30	85.07	87.29	77.30
PoC_14	8.89	9.00	.	16.70	9.67	6.47	13.38	2.30

Indicators of Perceived Challenge

Table 39

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q17 - How much demand currently exists among members of your community for [an MBN]? * Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]?	34	89.5%	4	10.5%	38	100.0%

Q17 - How much demand currently exists among members of your community for [an MBN]? * Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]? Crosstabulation

Count

		Q16 - Which factor do you anticipate would present the greatest challenge to implementing [an MBN]?				
		Cost of Equipment/Right-of-Way	Lack of Familiarity Among Staff	State Restrictions	Other	Total
Q17 - How much demand currently exists among members of your community for [an MBN]?	A great deal	2	0	1	1	4
	A lot	0	0	1	0	1
	A moderate amount	6	0	1	1	8
	A little	5	1	1	0	7
	None	8	1	1	4	14
Total		21	2	5	6	34

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.140[a]	12	.517
Likelihood Ratio	10.786	12	.547
Linear-by-Linear Association	.048	1	.826
N of Valid Cases	34		

a. 19 cells (95.0%) have expected count less than 5. The minimum expected count is .06.

Table 40

ANOVA - Factor is Perceived Challenge

		Sum of Squares	df	Mean Square	F	Sig.
Pop_2015	Between Groups	18143760546.736	3	6047920182.245	1.422	.256
	Within Groups	127624005306.205	30	4254133510.207		
	Total	145767765852.941	33			
Pop_2010	Between Groups	17470780498.641	3	5823593499.547	1.424	.255
	Within Groups	122688083926.800	30	4089602797.560		
	Total	140158864425.441	33			
Growth_Rate	Between Groups	43.912	3	14.637	.767	.522
	Within Groups	572.662	30	19.089		
	Total	616.574	33			
Med_Income_14	Between Groups	139488402.081	3	46496134.027	.262	.852
	Within Groups	5330691106.419	30	177689703.547		
	Total	5470179508.500	33			
Poverty_Rate_14	Between Groups	197.555	3	65.852	.867	.469
	Within Groups	2278.809	30	75.960		
	Total	2476.364	33			
House_Value_14	Between Groups	3307152755.451	3	1102384251.817	.624	.605
	Within Groups	52984225546.667	30	1766140851.556		
	Total	56291378302.118	33			
HS_Grad_Rate_14	Between Groups	11.163	3	3.721	.112	.953
	Within Groups	1000.185	30	33.339		
	Total	1011.347	33			
PoC_14	Between Groups	442.111	3	147.370	1.831	.163
	Within Groups	2415.223	30	80.507		
	Total	2857.334	33			

Table 41

	Q16 - Which factor do you anticipate would present the greatest challenge to implementing an MBN?				
	Cost of Equipment/Right-of-Way	Lack of Familiarity Among Citizens	Lack of Familiarity Among Staff	State Restrictions	Other
	Mean	Mean	Mean	Mean	Mean
Pop_2015	6125.14	.	2365.00	10477.80	67036.83
Pop_2010	6067.67	.	2241.50	10126.80	65800.83
Growth_Rate	-.53	.	-.69	2.64	-.62
Med_Income_14	47347.71	.	40530.50	43881.80	44194.17
Poverty_Rate_14	14.11	.	22.70	18.72	14.95
House_Value_14	89534.67	.	84750.00	115420.00	84550.00
HS_Grad_Rate_14	89.64	.	87.35	89.20	88.88
PoC_14	8.50	.	6.40	16.78	15.15

Indicators of Community Demand

Table 42

ANOVA - Factor is Level of Community Demand for MBNs

		Sum of Squares	df	Mean Square	F	Sig.
Pop_2015	Between Groups	35813864004.191	4	8953466001.048	2.361	.077
	Within Groups	109953901848.750	29	3791513856.853		
	Total	145767765852.941	33			
Pop_2010	Between Groups	34529668867.298	4	8632417216.825	2.370	.076
	Within Groups	105629195558.143	29	3642386053.729		
	Total	140158864425.441	33			
Growth_Rate	Between Groups	27.267	4	6.817	.335	.852
	Within Groups	589.307	29	20.321		
	Total	616.574	33			
Med_Income_14	Between Groups	240678474.732	4	60169618.683	.334	.853
	Within Groups	5229501033.768	29	180327621.854		
	Total	5470179508.500	33			
Poverty_Rate_14	Between Groups	194.404	4	48.601	.618	.653
	Within Groups	2281.960	29	78.688		
	Total	2476.364	33			
House_Value_14	Between Groups	3957782095.546	4	989445523.887	.548	.702
	Within Groups	52333596206.571	29	1804606765.744		
	Total	56291378302.118	33			
HS_Grad_Rate_14	Between Groups	148.887	4	37.222	1.252	.311
	Within Groups	862.461	29	29.740		
	Total	1011.347	33			
PoC_14	Between Groups	703.476	4	175.869	2.368	.076
	Within Groups	2153.858	29	74.271		
	Total	2857.334	33			

Table 43

	Q17 - How much demand currently exists among members of your community for [an MBN]?				
	A great deal	A lot	A moderate amount	A little	None
	Mean	Mean	Mean	Mean	Mean
Pop_2015	105400.25	1842.00	1488.00	13551.00	4126.00
Pop_2010	103490.00	1927.00	1521.75	13351.29	3987.36
Growth_Rate	.52	-4.41	-.82	.22	.31
Med_Income_14	45077.25	38287.00	42257.38	47729.71	47798.14
Poverty_Rate_14	17.05	25.30	15.54	17.27	13.31
House_Value_14	118925.00	73200.00	82637.50	91257.14	91809.14
HS_Grad_Rate_14	89.38	81.60	87.56	88.30	91.34
PoC_14	17.72	6.50	6.46	16.96	8.45

Appendix A - Survey Text

'Digital Utilities' Municipal Broadband Innovation Survey

Q1 Where have you learned about municipal broadband networks?
- ❑ Job Training (1)
- ❑ Popular Media (2)
- ❑ Professional Conferences (3)
- ❑ Professional Media (4)
- ❑ This Survey (5)
- ❑ Other (6) ____________________

Q2 What would you be most interested in learning about municipal networks?

Q3 Does your municipality own and operate a municipal broadband network?
- ❍ Yes (1)
- ❍ No (2)

Display This Question:
    If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q6 How long did your municipality's network take to plan and build in total months?

Display This Question:
    If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q7 How much did your municipality's network cost in total dollars?

Display This Question:
    If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q8 Which factor most strongly influenced your municipality's decision to implement a municipal broadband network?
- ❍ Availability of Existing Infrastructure (i.e. Municipal Employee Intranet) (1)
- ❍ Availability of Federal, State, or Other Grants (2)
- ❍ Demand From Citizens (3)
- ❍ Economic Development Opportunities (4)
- ❍ Other (5) ____________________

Display This Question:
If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q9 Which factor was the greatest challenge to creating your community's municipal broadband network?

- Cost of Equipment/Right-of-Way (1)
- Lack of Familiarity Among Citizens (2)
- Lack of Familiarity Among Staff (3)
- State Restrictions (4)
- Other (5) ____________________

Display This Question:
If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q10 Which factor is the most important benefit from your community's municipal broadband network?

- Accelerated Economic Development (1)
- Greater Broadband Adoption (2)
- Improved Broadband Access for Schools and Colleges (3)
- Improved Broadband Speed (4)
- Improved Communication Among City Staff (5)
- Improved Community Publicity/"Buzz" (6)
- Reduced Broadband Cost (7)
- Other (8) ____________________

Display This Question:
If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q11 For which factor(s) would you most describe your municipality's network as performing "Better than Expected"?

- Cost (1)
- Speed (2)
- Effectiveness at Closing 'Digital Divides' (3)
- Success at Improving Adoption Rates Among Community Members (4)
- Success at Promoting Economic Development (5)
- Reliability (6)

Display This Question:
If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q12 For which factor(s) would you most describe your municipality's network as performing "Worse than Expected"?

- ❍ Cost (1)
- ❍ Speed (2)
- ❍ Effectiveness at Closing 'Digital Divides' (3)
- ❍ Success at Improving Adoption Rates Among Community Members (4)
- ❍ Success at Promoting Economic Development (5)
- ❍ Reliability (6)

Display This Question:
If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q13 For which factor(s) would you most describe your municipality's network as "Meeting Expectations"?

- ❍ Cost (1)
- ❍ Speed (2)
- ❍ Effectiveness at Closing 'Digital Divides' (3)
- ❍ Success at Improving Adoption Rates Among Community Members (4)
- ❍ Success at Promoting Economic Development (5)
- ❍ Reliability (6)

Display This Question:
If Does your municipality own and operate a municipal broadband network? Yes Is Selected

Q14 What recommendations would you have for leaders who are considering implementing a broadband network?

Display This Question:
If Does your municipality own and operate a municipal broadband network? No Is Selected

Q5 Which factor do you anticipate would be the greatest benefit of a municipal broadband network?

- ❍ Accelerated Economic Development (1)
- ❍ Greater Broadband Adoption (2)
- ❍ Improved Broadband Access for Schools and Colleges (3)
- ❍ Improved Broadband Speed (4)
- ❍ Improved Communication Among City Staff (5)
- ❍ Improved Community Publicity/"Buzz" (6)
- ❍ Reduced Broadband Cost (7)
- ❍ Other (8) ____________________

Display This Question:

If Does your municipality own and operate a municipal broadband network? No Is Selected

Q16 Which factor do you anticipate would present the greatest challenge to implementing a municipal broadband network?

- Cost of Equipment/Right-of-Way (1)
- Lack of Familiarity Among Citizens (2)
- Lack of Familiarity Among Staff (3)
- State Restrictions (4)
- Other (5) ____________________

Display This Question:

If Does your municipality own and operate a municipal broadband network? No Is Selected

Q17 How much demand currently exists among members of your community for a municipal broadband network?

- A great deal (1)
- A lot (2)
- A moderate amount (3)
- A little (4)
- None (5)

Display This Question:

If Does your municipality own and operate a municipal broadband network? No Is Selected

Q18 Which best describes your community's plans for creating a municipal broadband network?

- No Plans to Implement (1)
- Considering Implementation Indefinitely (2)
- Likely to Implement Within the Next Year (3)
- Likely to Implement Within the Next Five Years (4)

Q19 How would you define "municipal broadband?"

Q19 What recommendations would you have for improving this survey?

Q20 What's your name and position title?

Q20 Would you like to participate in a telephone interview to share your expertise in greater detail? If so, please provide the best phone number to reach you at:

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